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PRELIMINARY REMARKS FOR THE SYMPOSIUM ON NEW APPROACHES IN THE STUDY OF NEOPLASIA

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(Read November 15, 1974)

IN DEVOTING an entire morning to the field of neoplasia, which of course includes not only cancer but benign tumors, the Committee on Meetings was recognizing an immense national and international effort. This effort has been going on for a long time but as most of you know has been accelerated in this decade by the conscious allotment of larger resources to the National Cancer Institute and the numerous organizations and agencies and individuals to whom it transmits federal funds, both by grants and by contracts. When Senator Yarborough as chairman of the Senate Subcommittee on Health gained approval of a senate resolution calling for the appointment of an outside committee charged with advising the senators on the merits of an expanded program of research, it was my privilege as a recent president of the American Cancer Society to serve on the committee under the chairmanship of Mr. Benno Schmdt and the co-chairmanship of Dr. Sidney Farber, and later of Dr. R. Lee Clark. The committee was asked to state whether they believed the state of knowledge in this field was sufficient to justify a sharp increase in federal funding, and only if the answer to this was affirmative to outline methods by which this could best be done, and to indicate the scope of such a program. In the preceding year, the appropriation for the National Cancer Institute had been slightly over $180 million and following the addition of approximately $20 million for a more intense program in virus research recommended by President Nixon and the addition of another $30 million by the Congress, the total appropriation has been stepped up to approximately $230 million.

The committee did report that it believed that sufficient basic knowledge was at hand to justify a sharp increase in funding and did outline a program much of which was incorporated in the National Cancer Act of 1971, which was signed into law by President Nixon just before Christmas of that year. Under this legislation the former National Advisory Cancer Council was converted and extended into a National Cancer Advisory Board with a chairman (other than the director of the National Cancer Institute) who has authority to call meetings. The Board was authorized to hold hearings. Furthermore, the new Board was charged with making an annual report to the president and the Congress on the whole cancer program so that it immediately became concerned with the intramural and contract aspects of the program, whereas the previous council had largely been concerned with the grant portion of the program.

Without taking the time to go into the various steps by which the program enlarged, suffice it to say that the appropriation for Fiscal '75 is likely to be in the $700 million range. I believe the final decision has not been made on this, pending further meetings of the House-Senate Conference Committee, action by the two houses, and signature by the president.

There are those who have serious doubts as to whether the basic knowledge about neoplasia is sufficiently far advanced to justify a program of this type. On the other hand, the discovery of the nature of DNA by Watson and Krick was extremely relevant and an immense amount of basic information has been added to that and to the tremendous accumulation of knowledge about tumors and their growth which had been going on rapidly since the time of Virchow and indeed for many years prior to his publications. It was not the thought of the Senate's Advisory Panel nor of the present Board that research in neoplasia was now reduced to so-called applied research, but rather that there were things known about cancer which were ready for clinical trials in the hope of helping people who were not being helped by established methods of treatment and also that the recent advances in basic knowledge increased our hopes that support of an additional scientific effort at basic levels in the broad field of neoplasia would lead to additional and significant information. I believe that this is occurring, not as dramatically as we would like but, nevertheless, in very important ways.

We are privileged this morning to hear from five individuals who have been contributing very effectively in the total effort. Their areas of interest are virology, cell biology, immunology, radiobiology, and cancer chemotherapy.

THE SEARCH FOR VIRUSES IN HUMAN CANCER

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(Read November 15, 1974, in the Symposium on New Approaches in the Study of Neoplasia)

INTRODUCTION

ONE of the most striking characteristics of the cancer cell is that the malignant state is transmissible to its progeny. Over the years a number of explanations have been proposed to explain the cellular heritability of the cancer state. Some of these hypothetical mechanisms are listed in table 1, along with their predicted consequences for sequence changes detectable by the technique of nucleic acid hybridization. It should be noted that the methods generally used to detect the heteroduplexes require stretches of complementary homology involving 50 or more hydrogen-bonded base pairs. Thus, for example, somatic mutations in a structural or regulatory gene are not likely to produce more than a few base changes and therefore could not be detected by molecular hybridization procedures. The same is true for chromosomal translocations or inversions since they would generate only minor sequence differences. The third mechanism of chromosomal imbalance resulting from the loss or extra duplication of one or more of the chromosomal complements can lead only to the gain or loss of pre-existent sequences.

The fourth mechanism is a possibility that emerged from the study of the so-called "lysogenizing" or "transducing" phages. Here one has a phenomenon in which the virus inserts its genetic information into the genome of the host cell. If the virus involved is a deoxyribonucleic acid (DNA) agent, there are no chemical problems posed and the mechanism of insertion of DNA into DNA via prior circularization is quite well understood (9). If, however, the virus involved is a ribonucleic acid (RNA) virus, then a mechanism is required for making a DNA transcript of the viral RNA, which can then be inserted into the DNA. This hypothesis then becomes formally identical to the early "provirus" hypothesis of Temin (41), which ultimately led to the discovery of "reverse transcriptase" in the RNA tumor viruses (4, 42).

The fifth hypothesis involves a heritable phenotypic modification unaccompanied by any change in the genetic information, quite analogous to what is presumed to occur in cellular differentiation. Here we assume the pre-existence of a silent malignant segment of genetic information that can undergo a self-reinforcing derepression. It is not too difficut to devise such mechanisms theoretically. For example, one could assume that when the repressor protein is free from the DNA, it can serve as a necessary functional subunit of an enzyme complex that synthesizes a molecule that can both stabilize the enzyme complex and also act as an inducer to derepress the malignant segment. Thus any intrinsic or extrinsic factor that dislodges the original repressor protein will initiate a chain of events that will insure that the derepression will be maintained and cytoplasmically transmitted. If the repressed malignant segment codes for an RNA tumor virus, the fifth hypothesis becomes equivalent to the "virogene-oncogene" hypothesis of Todaro and Huebner (43).

In what follows we describe experiments to decide among these alternatives for particular human neoplasias. There are several aspects of this type of analysis that merit explicit expression. The five mechanisms noted do not constitute an exhaustive list of all possibilities. They do have the advantage of being sufficiently precise to permit the deduction of their consequences. Further, they are not mutually exclusive in either a general or a particular sense. Various forms of cancer in the same animal might be mediated by different mechanisms and similarly for the same cancer in different animals. Finally, more than one of the mechanisms listed might be implicated in the occurrence of one and the same neoplasm. Thus, all one can hope to decide by experiment is whether one of the mechanisms is involved in a specific neoplasm in a particular animal. Support for one mechanism in a particular instance does

TABLE 1

HYPOTHESES OF CANCER ETIOLOGY AND THEIR DNA SEQUENCE CONSEQUENCES

Hypothesis	Mechanism	Sequence change detectable by hybridization
1. Mutation	Individual base changes in structural or regulatory genes	None
2. Chromosomal rearrangement	Translocation, inversion, etc.	None
3. Chromosomal imbalance	Loss or duplication	Loss or gain of *old* sequences
4. Transduction	Insertion of viral genes	Gain of *new* sequences
5. Phenotypic	Self-reinforcing depression of silent genes	None

not eliminate the others; it simply says they cannot be the sole cause.

The fourth mechanism is unique in making two experimentally useful predictions. It is the only one that demands the active participation of a viral agent at some point of the carcinogenic process. It is also the only one that predicts the acquisition of new and viral-related information by the malignant cell. It is evident that any attempt to examine human cancer from this point of view must start with a search for evidence of viral agents in the human disease.

ANIMAL VIRAL ONCOLOGY

We had perhaps best begin by explicitly noting a bias stemming from our previous experiences with RNA viruses and our assessment of the information available on the relation between viruses and cancer. Both DNA and RNA tumor viruses have been identified as etiologic agents in laboratory experiments. However, we decided to concentrate our initial efforts on the RNA oncornaviruses, a choice made for two reasons. One is that the RNA oncogenic agents predominate quantitatively in the animal systems studied. The second is that it is the RNA tumor viruses that have been repeatedly demonstrated to cause tumors in their indigenous hosts. Thus, from the point of view of the natural history of the disease, the RNA oncogenic viruses appeared to us as the more probable "natural" candidates for etiologic agents of cancer in the animal kingdom, including man.

Over the past fifty years, animal viral oncology has amassed a considerable fund of information concerning the so-called B-type and C-type RNA tumor viruses (15). These agents have been implicated in a variety of cancers in a wide spectrum of animals. In many instances, convincing evidence has been obtained by inoculation of purified viruses into susceptible animals in experiments that satisfy Koch's criteria for the identification of the causative agent of a particular disease.

Our working assumption was based on the improbability that cancer in man would have so different an etiological basis that the information provided by animal experiments would be irrelevant to the human disease. If this be the case, one might well wonder why it has been so difficult to provide acceptable evidence for a viral agent in human cancer. A plausible explanation emerges from an examination of the historical development of animal viral oncology. Forty to fifty years ago, it was as difficult to identify viruses in animal tumors as it is today in the human neoplasias. The experimental picture changed dramatically as the result of a decision by geneticists that had a profound serendipic effect on the subsequent development of cancer research. A group of investigators, including Little, Strong, MacDowell and Furth (15), developed highly inbred strains of mice, some of which were characterized by a high frequency of various neoplasias, including mammary tumors, leukemias, etc. The intent was of course to mate these with low-frequency strains and from the distribution of the characteristic cancer phenotype deduce the genetic factors underlying susceptibility and resistance to the disease. What occurred unexpectedly, however, was that in the course of developing the inbred stocks of high cancer frequency, a genetic background was inadvertently created permitting the tumor viruses to multiply to levels that made their identification inevitable. This, along with the introduction in 1951 by Gross of neonatal mice for virus assay, did much to open up the field of viral oncology.

Those who are concerned with human neoplasias are for the most part faced with the same difficulties encountered by the early animal oncologists before inbred strains were available. It follows that the detection of putative human viral agents requires more sensitive devices than those which sufficed to establish their presence in the inbred animal systems. In searching for such tools, we quite naturally turned to molecular hybridization and the other methodologies developed by molecular biologists in the past several decades.

Our investigations evolved through a number of stages that are conveniently identified by the questions we posed sequentially for experimental resolution as our studies progressed.

1) Do human neoplasias contain RNA molecules possessing detectable homology to the RNA of tumor viruses known to cause similar cancers in animals?

2) If a positive outcome is obtained, do the RNA molecules identified in tumors possess the size and physical association with reverse transcriptase that characterize the RNA of the animal oncornaviruses?

3) If such RNA exists in human tumors, is it encapsulated in a particle possessing the density and size of the RNA tumor viruses?

4) Is the RNA of human tumor particles homologous to the RNA of the viruses causing the corresponding disease in animals?

5) The virogene concept proposes that all animals prone to cancer carry in their germ line a complete copy of the information required to convert a cell from normal to malignant and for the production of tumor virus particles. Is this concept valid for randomly bred populations and in particular for the human disease?

THE ANIMAL MODELS AS A POINT OF DEPARTURE

To understand better the biological rationale underlying the experiments to be described, it is useful to summarize briefly some of the salient features of the animal model systems used as a guide. Table 2 lists a representative group of animal viruses, including those actually employed to generate the molecular probes used. There are two avian viruses, myeloblastosis virus (AMV) and Rous sarcoma virus (RSV), that cause leukemias and sarcomas in chickens. In addition, we have the murine leukemia virus (MuLV) and murine sarcoma virus (MuSV) that induce similar diseases in mice, and finally the murine mammary tumor virus (MMTV), which is the unique etiologic agent for mammary tumors.

When these are examined for sequence homologies among their nucleic acids, a rather informative pattern emerges. It will be noted that the two chicken agents (AMV and RSV) have sequences in common but do not show detectable homology with any of the murine agents. Turning to the murine viruses, we find that the nucleic acids of the leukemia, lymphoma, and sarcoma agents are homologous to one another but not to either of the two avian agents or to the mammary tumor virus. Finally, the mouse mammary tumor virus has a singular sequence homologous only to itself.

It is important to understand that a plus sign does not indicate identity but simply sufficient similarity to be detectable by the relaxed hybridization conditions used in these initial exploratory experiments. Similarly, a negative sign does not imply a complete absence of sequence homology but rather that none was detectable by the procedures used.

If analogous virus particles are associated with the corresponding human diseases, certain predictions may be hazarded on the basis of the specificity patterns exhibited in table 2, and these may

TABLE 2

COMPARISON OF SOME REPRESENTATIVE ONCORNAVIRUSES

Virus	Indigenous host	Homology*					Disease
		AMV	RSV	MuLV	MSV	MMTV	
AMV	Chicken	+	+	−	−	−	Leukemia
RSV (RAV)	Chicken	+	+	−	−	−	Sarcoma
MuLV	Mouse	−	−	+	+	−	Leukemia, lymphoma
MSV (MuLV)	Mouse	−	−	+	+	−	Sarcoma
MMTV	Mouse	−	−	−	−	+	Breast cancer

* The results of molecular hybridizations between [^{3}H]DNA complementary to the various RNAs and the indicated RNAs. The plus sign indicates the hybridizations were positive and the negative sign indicates none could be detected.

be listed as follows:

1) In view of the lack of homology between the avian and murine agents, it is unlikely that human agents, should they exist, would show homology to the avian group.

2) It follows that the murine tumor viruses would represent a more hopeful source of the molecular probes to search for similar information in the analogous human cancers.

3) If particles are found to be associated with human leukemias, sarcomas, and lymphomas, their RNAs might show homology to one another and possibly to that of the murine leukemia virus.

4) If RNA particles are identified in human breast cancer, these should not exhibit homology to the RNA of the viruslike particles associated with the human lymphoid neoplasias or to RLV RNA but might exhibit some homology to the RNA of the murine mammary tumor virus.

On the basis of availability and the considerations outlined above, it is clear why the murine agents were initially chosen for producing the necessary molecular probes to look for corresponding information in the human disease. Furthermore, the desire to monitor the biological consistency of our findings dictated that we examine in parallel the human neoplasias listed. This would permit us to determine quickly whether our findings in humans mirrored biologically what was known from the animal experimental models. For this purpose, from the onset, we focused our efforts on the lymphoid neoplasias and on breast cancer.

MOLECULAR HYBRIDIZATION WITH RADIOACTIVE DNA PROBES

To answer the first question, whether human tumors contain virus-related RNAs, we naturally turned to the use of DNA-RNA hybridization (38), which we designed some dozen years ago to answer questions of almost precisely this nature in the case of virus-infected bacteria. The method depends on the ability of any piece of single stranded DNA to find its complementary RNA and form, under the proper conditions, a double-stranded hybrid structure. The reaction is highly specific and has proved to be of considerable value in molecular biology over the past decade.

The radioactive DNA needed was synthesized by supplying detergent-disrupted virus preparations with magnesium and the four deoxyriboside-triphosphates required, one of them being labeled with tritium. When the synthesis is finished, the protein and the RNA present are eliminated and the residual radioactive DNA purified to completion. Each [^{3}H]DNA preparation must be rigorously monitored for the specificity of its hybridizability to its appropriate template. Thus, each probe is challenged with its homologous RNA as well as with the other unrelated viral RNAs. Further, normal and cancer tissue RNAs from animal models were used to check the reliability of the hybridizations. Only if a probe demonstrated the required specificity in these test hybridizations was it used for the subsequent experiments with human material.

There are certain features built into these exploratory experiments that are worthy of explicit mention. We of course did not know at the outset whether there would be any homology between the murine viruses and any putative human agents. At the time RLV and MMTV were among the few mammalian oncornaviruses available in adequate supply and we could only hope that they would have sufficient homology to be used for our purpose. However, even if this hope were realized, it would hardly be likely that the homology would be extensive and therefore hybridization experiments had to be carried out under conditions sufficiently relaxed to yield a reaction with a limited level of homology. Further, the method of detection of hybrid structures would have to possess a low background noise level so that weak positive reactions would be readily identified and distinguished from negative outcomes. Finally, the $C_{r_0}t$ (concentration of nucleotides in moles per liter × time in seconds) values of the annealing reactions were deliberately adjusted to be adequate for multiple (ten or more) rather than individual copies per cell. This was done in order to magnify any existent difference between normal and malignant tissue. We were not initially concerned with determining whether normal cells could produce the same or related malignant messages at very low levels.

All of these considerations entered into the design of the detailed methodology used and are diagrammed in figure 1. After monitoring for specificity, the purified viral-specific [^{3}H]DNA is mixed with cytoplasmic RNA prepared from a variety of human tumors and annealed under the conditions indicated. The hybridizations were always carried out with a vast excess of tumor RNA. Since the viral-specific [^{3}H]DNA is small compared with the RNA, any complexes formed between them will behave physically more like RNA than like DNA. Such complexes are readily detected by isopycnic separation in equilibrium density gradients of Cs_2SO_4. At the end of the centrifugation, the distribution of [^{3}H] DNA is examined across the gradient. Any uncomplexed DNA will remain at a density corresponding to about 1.45. DNA molecules that have annealed partially or completely to large RNA molecules will band at or near the density of RNA ($\rho = 1.65$).

The movement of the [^{3}H]DNA to the RNA region is then the signal that the probe used has found complementary sequences in the tumor RNA with which it is being challenged. It is important to emphasize that this test is essentially a qualitative one and does not measure how good the fit is in the duplex. A positive outcome says only that sufficient homology exists between the tritiated DNA probe and some RNA molecules in the tumor RNA sample to form a complex stable enough to be detected by the test used. Once such structures are identified, the fidelity of the pairing can be examined by a temperature-melt analysis. These more sophisticated examinations demand more hybrids than we could initially produce. It was therefore necessary to postpone these more informative experiments until more efficient probes became available.

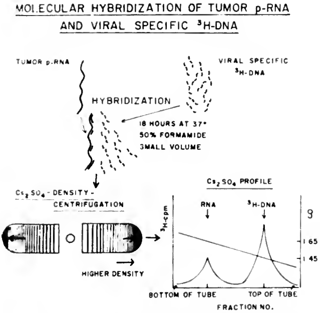

FIG. 1. Molecular hybridization and detection with viral-specific [^{3}H]DNA and tumor RNA (see text for further details).

TABLE 3

HOMOLOGIES AMONG HUMAN NEOPLASTIC RNAs AND ANIMAL TUMOR VIRAL RNAs

Viral RNAs	Human neoplastic RNAs			
	Breast cancer	Leukemia	Sarcoma	Lymphoma
MMTV	+	−	−	−
RLV	−	+	+	+
AMV	−	−	−	−

The results of molecular hybridization between [^{3}H]DNA complementary to the various viral RNAs and pRNA preparations from the indicated neoplastic tissues. The plus sign indicates that hybridizations were positive and the negative sign, that none could be detected (18).

We understandably began by exploring those human malignancies for which there were suitable animal models and viruses. These included adenocarcinoma of the breast (2, 3, 34), the leukemias (18), the sarcomas (23), and lymphomas (19). The leukemias examined encompassed both acute and chronic varieties of the lymphatic and myelogenous types. The human sarcomas studied included fibro sarcomas, osteogenic sarcomas, and liposarcomas. The series on lymphomas contained Hodgkin's disease, Burkitt's tumors, lymphosarcomas, and reticulum cell sarcomas. Control adult and fetal tissues were always examined in parallel and these were invariably negative. In the case of breast cancer, the two benign diseases, fibroadenoma and fibrocystic disease, were also included and found to be negative.

Table 3 summarizes in diagrammatic form the outcome of this survey of human neoplasias with the animal virus probes. The plus signs indicate that the corresponding [^{3}H]DNA formed complexes with the indicated tumor RNAs and the negative signs that no such complexes were detected. The proportion of positives among those labeled plus in these earlier studies (2, 3, 18, 19, 23, 34) ranged from about 67 per cent for breast cancer to 92 per cent for the leukemias. As our technology improved, so has the percentage of positive tests among the neoplastic samples.

What is most noteworthy of the pattern exhibited in table 3 is its concordance with the predictions deducible from the murine system. Thus, human breast cancer contains RNA homologous only to that of the murine mammary tumor virus (MMTV). Human leukemias, sarcomas, and lymphomas all contain RNA showing sufficient homology to that of the murine leukemia virus (RLV) to make a stable duplex. These lymphoid neoplasias contain no RNA homologous to the MMTV RNA. Finally, none of the human tumors contain RNA detectably related to that of the avian myeloblastosis virus (AMV). Recently Gallo and his associates (11) have confirmed the homology of leukemic RNA to that of RLV and in the process have shown even closer relation to the RNA of a simian sarcoma virus. In summary, the specificity pattern of the unique RNA found in the human neoplasias is in complete agreement with what has been described for the corresponding virus-induced malignancies in the mouse.

Needless to say, the existence of this remarkable concordance does not establish a viral etiology for these diseases in man. The next step requires performance of experiments designed to answer the second and third questions raised in the introduction, i.e., those relating to the size of the RNA being detected and whether it is associated with a reverse transcriptase in a particle possessing other features of complete or incomplete virus particles. We now turn our attention to the description of these techniques and their application to the analysis of human malignant tissue.

SIMULTANEOUS DETECTION TEST FOR REVERSE TRANSCRIPTASE AND RNA OF HIGH MOLECULAR WEIGHT

What we sought was a method of detecting the presence of particles similar to the RNA tumor viruses in human material that would be simple, sensitive, and sufficiently discriminating so that a positive outcome could be taken as an acceptable signal of the presence of a viruslike agent. To achieve this goal, we devised a test that depended on the simultaneous detection of two diagnostic features of the animal RNA tumor viruses.

The oncornaviruses exhibit two identifying characteristics. They contain a large (1×10^7 daltons in molecular weight) single-stranded RNA molecule having a sedimentation coefficient of 60 to 70S, often referred to as high molecular weight (HMW) RNA. They also have reverse transcriptase (4, 42), an enzyme that can use the viral RNA as a template to make a complementary DNA copy (37).

The possibility of a concomitant test for both the enzyme and its template was suggested by our prior experience with RNA transcriptase. We found (38) that the growing RNA chain could be detected as a complex with its DNA template. Similarly, examination of the early reaction intermediate (31, 37) of the reverse transcriptase reaction revealed that the initial DNA product was found complexed to the large 70S RNA template. These structures can be detected by the unusual position of the newly synthesized small tritiated DNA products in Cs_2SO_4 density gradients, glycerol velocity gradients, and acrylamide gel electrophoresis (8). The most informative assay is to subject the isotopically labeled product to sedimentation analysis prior to the removal of the RNA. If the labeled DNA product behaves as if it is a 70S molecule, and if it can be shown that it does so because it is complexed to a 70S RNA molecule, then evidence is provided for the presence of a reverse transcriptase using a 70S RNA template. One may then tentatively conclude that the material examined contains particles similar to the RNA tumor viruses.

It was on this basis that Schlom and Spiegelman (33) developed the simultaneous detection test, which was used to demonstrate (35) the presence in human milk of particles containing 70S RNA and a reverse transcriptase. The test was modified (16) to be applicable to tumor tissue using the mouse mammary tumor as the experimental model.

Figure 2 diagrams the procedure used. Tumor cells are first broken by the use of a Dounce homogenizer and the nuclei and large cell debris are removed by low-speed centrifugation. The supernate is subjected to trypsin digestion to inactivate any nucleolytic enzymes and the trypsin is neutralized by trypsin inhibitor. The supernate is then centrifuged at a $150{,}000 \times g$ to yield a cytoplasmic pellet containing virus particles, if present. The resulting pellet is then banded isopycnically in a sucrose density gradient and the fraction between 1.16 and 1.19 gm/ml collected and concentrated by centrifugation. This pellet is then treated with a nonionic detergent (0.1 per cent of NP-40) to disrupt possible viral particles and is used in an endogenous reverse transcriptase reaction. It should be noted that detergent disruption is essential for a positive reaction, indicating that the enzyme and template are enclosed in a structure that must be opened up to make them accessible to the substrates. Actinomycin D is always included (100–200 μg/ml) to inhibit DNA-instructed DNA

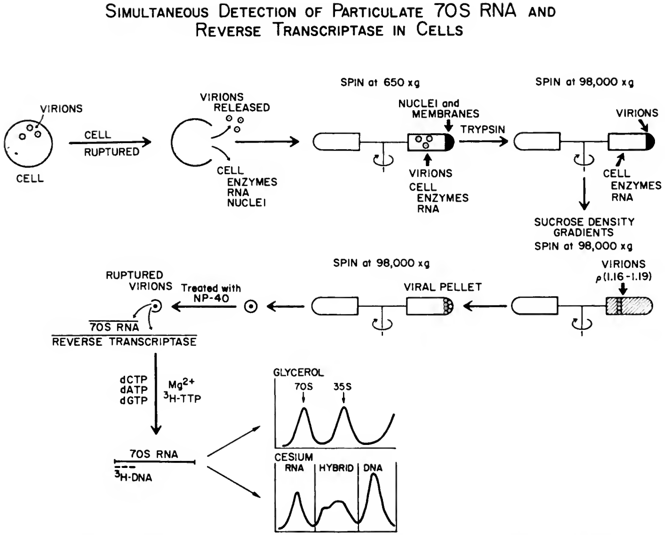

FIG. 2. Simultaneous detection test for 70S RNA and reverse transcriptase in neoplastic tissue (see text for further details).

synthesis. The product of the reaction with its RNA template is freed of protein and then analyzed in a glycerol velocity gradient to determine the sedimentation coefficient of the [^{3}H]DNA as well as in a Cs_2SO_4 equilibrium gradient to determine its density.

The presence of particles encapsulating 70S RNA and reverse transcriptase will be indicated by the appearance of a peak of newly synthesized DNA traveling at a speed corresponding to a 70S RNA molecule. That its apparently large size is due to its being complexed to a 70S RNA molecule can be readily verified by subjecting the purified nucleic acid to ribonuclease prior to velocity examination and this should result in the disappearance of the "70S" [^{3}H]DNA. Similarly, if the reaction is positive, newly synthesized DNA should appear in the RNA and hybrid regions of a Cs_2SO_4 density gradient, and this again should be eliminated by prior treatment with ribonuclease.

The simultaneous detection test was first applied to human breast cancer (1). Figure 3 exemplifies a positive reaction with material obtained from a malignant adenocarcinoma and treated as outlined in figure 2. Here we see the 70S DNA complex observed with the P-100 fraction and it is evident that this complex is an RNA-dependent one since prior treatment with ribonuclease eliminates the [^{3}H]DNA from the 70S region of the velocity gradient. In this series, 38 adenocarcinomas and 10 nonmalignant controls were examined in this manner. It was found that 79 per cent of the malignant samples were positive for the simultaneous detection reaction and all of the control samples from normal tissue and benign tumors were negative.

The data obtained therefore indicated that one

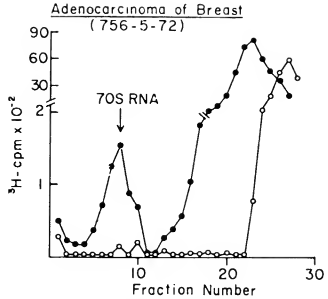

FIG. 3. Effect of ribonuclease on the detection of the high-molecular-weight RNA-[^{3}H]DNA complex. Breast tumor tissue (adenocarcinoma 756-5-72) was processed as described in fig. 2. The viral pellet (P-100) was suspended in 0.01 M Tris-HCl (*p*H 8.3) and divided into two equal parts. A standard RNA-instructed DNA polymerase reaction was performed on one part of the P-100 fraction; after incubation for 15 min at 37°, the nucleic acid complex was extracted with phenol-cresol and was sized on a 30–10 per cent linear glycerol gradient (●---●). After disruption with detergent, the other half of the P-100 fraction was incubated in the presence of RNase A (50 µg/ml) and RNase T$_1$ (50 µg/ml) for 15 min at 25°. A standard RNA-instructed DNA polymerase reaction was then performed (○---○) (1).

can, with a high probability, find in human breast cancers particulate elements that encapsulate RNA-instructed DNA polymerase and a 70S RNA. It was of obvious interest to see whether this reaction peaked in the density region characteristic of an RNA tumor virus. To this end, aliquots of pellet fractions that gave positive simultaneous detection tests were first subjected to sucrose equilibrium centrifugation in a linear gradient of 25 to 50 per cent sucrose. The gradient was then divided into 10 equal fractions, which were diluted to 15 per cent sucrose and spun at 100,000 × *g* for 1 hr to pellet any particles present. Each of these pellets was then tested to determine the distribution in the density gradient of the reaction that yields a 70S RNA-instructed DNA-synthesizing activity. It is clear from the results shown in figure 4 that particles possessing the reverse transcriptase activity and its 70S RNA template localize at a density between 1.16 and 1.19 g/ml, the density characteristic of the oncogenic viruses.

APPLICATION OF THE SIMULTANEOUS DETECTION TEST TO THE LEUKEMIAS

In the study of the leukemias (5), peripheral leukocytes were prepared from the buffy coats of both leukemic and nonleukemic control patients. Cells were disrupted and fractionated as described in figure 2. Representative experiments examining the effects of ribonuclease treatment of the product and omission of one of the deoxytriphosphates during the reaction are shown in figure 5. We see the telltale 70S peaks of DNA synthesized by the pellet fractions from the leukocytes of patients with acute lymphoblastic and acute myelogenous leukemias. The elimination of the complex by prior treatment with ribonuclease (fig. 5*A*) shows that the tritiated DNA is indeed complexed to a 70S RNA molecule. Further, the omission of dATP (fig. 5*B*) leads to a failure to form the 70S complex, a result expected if the reaction is in fact leading to the synthesis of a

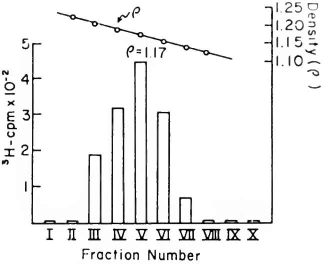

FIG. 4. Density of 70S RNA and RNA-instructed DNA polymerase activity in extracts of human mammary tumors by sucrose gradient centrifugation. A P-100 pellet was prepared from human mammary tumor. The pellet was suspended in Tris-NaCl-EDTA buffer and layered on a linear gradient of 50–25 per cent sucrose in the same buffer and spun at 25,000 rpm in a SW27 (Spinco) rotor at 4° for 195 min. The gradient was dripped from below and ten equal fractions were collected; fractions were then diluted with Tris-NaCl-EDTA buffer to a sucrose concentration of less than 15 per cent. Each fraction was then spun at 100,000 × *g*. The amount of 70S [^{3}H]DNA synthesized by an endogenous RNA-instructed DNA polymerase was determined by glycerol velocity centrifugation.

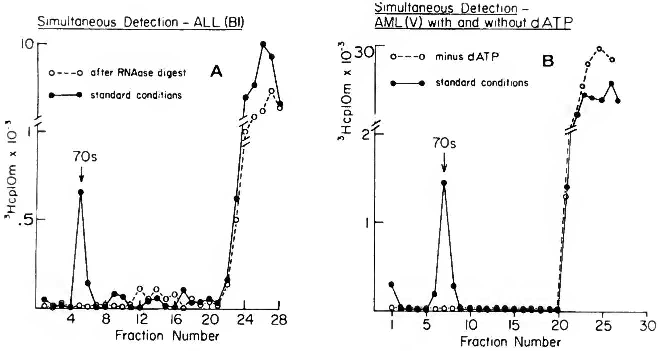

FIG. 5. Detection of 70S RNA[^{3}H]DNA complex in human leukemic cells. 1 gm of leukemic WBC was washed in 5 ml of 0.01 M NaCl, 0.01 M Tris-HCl, *p*H 7.4, resuspended in 4 ml of 5 per cent sucrose, 0.005 M EDTA, 0.01 M Tris-HCl, *p*H 8.3, and ruptured with three strokes of a Dounce homogenizer. The nuclei were removed by low speed centrifugation (2,000 *g*, 5 min, 2°). The supernatant was brought to a final concentration of 1 mg/ml trypsin (Worthington) and incubated at 37° for 30 min. A tenfold excess of lima bean trypsin inhibitor (Worthington) was added (final concentration 3 mg/ml) and the solution again centrifuged at 2,000 *g* for 5 min at 2°. The supernatant was then centrifuged at 45,000 rpm for 60 min at 2°. The resulting cytoplasmic pellet was resuspended in 0.5 ml of 0.01 M Tris-HCl, *p*H 8.3, brought to 0.1 per cent Nonidet P-40 (Shell Chemical Co.) and incubated at 0° for 15 min. DNA was synthesized in a typical reverse transcriptase reaction mixture (final vol 1 ml) containing: 50 μmol of Tris-HCl, *p*H 8.3, 20 μmol NaCl, 6 μmol $MgCl_2$, 100 μmol each of dATP, dGTP, dCTP, and 50 μmol-[^{3}H]dTTP (Schwarz Biochemical, 800 cpm per pmol). 50 μg/ml actinomycin D were added to inhibit DNA-instructed DNA synthesis. After incubation at 37° for 15 min, the reaction was adjusted to 0.2 M NaCl and 1 per cent SDS, and deproteinized by phenol-cresol extraction. The aqueous phase was layered on a 10 to 30 per cent gradient of glycerol in TNE buffer (0.01 M Tris-HCl, *p*H 8.3, 0.1 M NaCl, 0.003 M EDTA) and centrifuged in a SW-41 rotor Spinco at 40,000 rpm for 180 min at 2°. Fractions were collected from below and assayed for TCA-precipitable radioactivity. In this, as in all sedimentation analysis, 70S RNA of the avian myeloblastosis virus was used as a marker.

(*A*) One aliquot of product was run on the gradient as a control and the other was pretreated with 20 μg of RNase 1 (Worthington) for 15 min at 37° prior to sedimentation analysis. (*B*) Reactions with and without dATP (5).

proper heteropolymer. In similar experiments, it was shown that omission of either dCTP or dGTP also resulted in the absence of the 70S RNA-[^{3}H]DNA complex, all of which argues against nontemplated end addition reactions.

In some cases leukemic cells were obtained in amounts adequate to permit a more complete characterization of the product. Hybridization of the human product to the appropriate viral RNAs provides the most revealing information since it tests sequence relatedness to known oncogenic agents. We summarize in table 4 the results of examining the peripheral leukocytes of 23 patients, all in the active phases of their disease, including both acute and chronic leukemias. Of the 23 leukemic patients examined, 22 showed clear evidence that their peripheral leukocytes contained particles mediating a reaction leading to the appearance of endogenously synthesized DNA in the 70S region of a glycerol gradient. Nine of these were tested for ribonuclease sensitivity and in all cases the complexes were destroyed. In nine others, the DNA was recovered from the complex and annealed to RLV RNA and to either MMTV RNA or AMV RNA. In all nine, hybridizations occurred with RLV RNA and not to either of the unrelated MMTV RNA or AMV RNA. In four patients, enough

TABLE 4

Simultaneous Detection of 70S RNA and Reverse Transcriptase in Leukemic Cells (5)

Leukemias	Simultaneous detection cpm	RNase sensitivity	Hybridization to RLV-RNA	Hybridization to AMV-RNA or MMTV-RNA
Acute lymphatic				
OD	400	+	NT	NT
Sm	95	+	NT	NT
Acute lymphatic/lymphosarcoma				
Hl	805	+	+	–
Hz	200	NT	+	–
Bx	185	+	NT	NT
St	105	+	NT	NT
Acute myelogenous				
Ge	170	+	NT	NT
De	985	+	+	–
Be	305	+	NT	NT
Vi	1,295	+	+	–
Sh	1,010	NT	+	–
S	115	NT	+	–
Du	415	NT	+	–
He	400	NT	+	–
Bl	605	+	NT	NT
Ga	215	+	+	–
C	285	+	NT	NT
Pe	0	NT	NT	NT
Ne	1,400	NT	+	–
Chronic lymphatic				
Ri	200	+	NT	NT
Chronic myelogenous				
Ec	405	NT	+	–
Har	390	NT	+	–
An	600	NT	+	–

NT = Not Tested

DNA complex was formed to permit a complete characterization of the product. In all four, the DNA complexes were destroyed by ribonuclease and the purified DNA hybridized uniquely to RLV RNA.

It is noteworthy that positive outcomes were observed in more than 95 per cent of the leukemic patients whether they were acute or chronic, lymphoblastic or myelogenous. Thus, despite their disparate clinical pictures and differing cellular pathologies, these various types of leukemias have similar, though probably not identical, virus-related information.

In contrast with these results are those obtained with a control series of eighteen white blood samples from nonleukemic patients. These included nine with elevated white blood cell counts (in the range of 25,000/mm^3) due to a variety of disorders, including polycythemia vera. None of these exhibited evidence of an RNA-DNA complex that was ribonuclease-sensitive and contained DNA that hybridized specifically with RLV RNA. Thus, none of the eighteen nonleukemic individuals exhibited evidence of the specific 70S RNA-directed DNA synthesis found in virtually all of the leukemic patients examined.

IMPLICATIONS OF SIMULTANEOUS DETECTION TESTS ON HUMAN BREAST CANCER AND THE LEUKEMIAS

The experiments we have just summarized on human breast cancer and the leukemias were designed to probe further the etiological significance of our exploratory investigations (2, 18), which identified in these neoplasias RNA homologous to those of the corresponding murine oncornaviruses. The data obtained with the simultaneous detection test established that at least a portion of the tumor-specific virus-related RNA we were detecting was a 70S RNA template physically associated with a reverse transcriptase in a particle possessing a density between 1.16 and 1.19 g/ml, three of the diagnostic features of the animal RNA tumor viruses. Further, the DNA synthesized in the particles from both classes of neoplasias hybridized uniquely to the RNA of the corresponding oncornavirus. Note that this last result is complementary to and completes the logic of our experimental approach. We started out by using animal tumor viruses to generate [^{3}H]DNA probes that were used to find related RNA in human neoplastic tissue. We concluded by using analogous human particles to generate [^{3}H]DNA probes, which were then used to determine sequence relatedness to the RNA of the relevant oncornaviruses. None of the human probes hybridized to the avian viral RNA. The probe generated by the particles from human breast cancer was homologous only to the RNA of mouse mammary tumor virus, whereas the human leukemic probe was related in sequence only to RLV RNA, the murine leukemic agent. The biologically logical consistency of these results adds further weight to their relevance to the human disease.

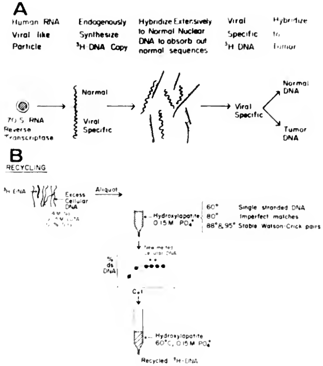
A
Human RNA Viral like Particle
Endogenously Synthesize ^{3}H DNA Copy
Hybridize Extensively to Normal Nuclear DNA to absorb out normal sequences
Viral Specific ^{3}H DNA
Hybridize to Tumor
70 S RNA Reverse Transcriptase
Normal
Viral Specific
Viral Specific
Normal DNA
Tumor DNA
B
RECYCLING
^{3}H DNA
Excess Cellular DNA
Aliquot
Hydroxylapatite 0.15 M PO$_4$
60° Single stranded DNA
80° Imperfect matches
88° & 95° Stable Watson-Crick pairs
% ds DNA
C$_0$t
Hydroxylapatite 60°C, 0.15 M PO$_4$
Recycled ^{3}H-DNA

FIG. 6. (*A*) Generation of [^{3}H]DNA by human leukemic particles and hybridization of sequences shared with normal DNA. (*B*) Separation of leukemia-specific sequences by hydroxyapatite chromatography. See text for further details.

ON THE PROBLEM OF GERM-LINE TRANSMISSION OF VIRAL INFORMATION

We now come to grips with the virogene-oncogene concept (43), which derives from animal experiments and argues that all animals prone to cancer contain in their germ line at least one complete copy of the information necessary and sufficient to convert a cell from normal to malignant and produce the corresponding tumor virus. This hypothesis presumes that the malignant segment usually remains silent and that its activation by intrinsic or extrinsic factors leads to the appearance of virus and the onset of cancer.

There are various ways of testing the validity of the virogene-oncogene hypothesis, but the pathways differ in the technical complexities entailed. One approach commonly used attempts to answer the question: does every normal cell contain at least one complete copy of the required virus-related malignant information? The methodologies used included the techniques of genetics, chemical virus induction, and molecular hybridizations. However, for a variety of reasons, none of these gave, or could give, conclusive answers. Genetic experiments do not readily distinguish between susceptibility genes and actual viral information. Further, even if genetic data succeeded in identifying some structural viral genes, it would still be necessary to establish that *all* the viral genes are represented in the genome. Attempts to settle the question by demonstrating that every cell of an animal can be chemically induced to produce viruses have thus far, for obvious reasons, not been tried. The best that has been achieved along these lines is to show that cloned cells do respond positively. However, the proportion of clonable cells is small and *clonability may well be a sign of prior infection with a tumor virus.*

Finally, the quantitative limitations of molecular hybridization make it almost impossible to provide definitive proof that each cell contains one complete viral copy in its DNA. Although it is not very difficult to show that 90 per cent of the information is present, it is the last 10 per cent that constitutes the insurmountable barrier and 10 per cent of 3×10^6 daltons amounts to a far from trivial 3×10^5 daltons, the equivalent of about one gene.

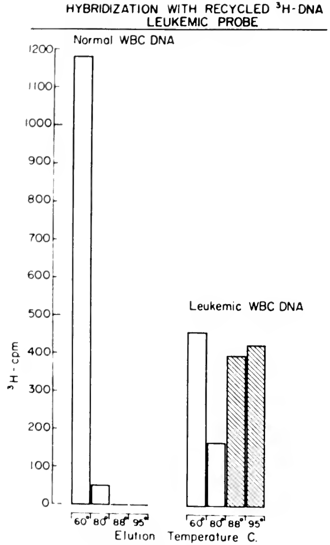

FIG. 7. Hydroxyapatite elution profile of a hybridization reaction of recycled leukemic [^{3}H]DNA to nuclear DNA from normal leukocytes and from leukemic leukocytes of the patient from which the [^{3}H]DNA was derived.

A useful way to obviate these technical difficulties is to invert the problem. Instead of asking whether one complete copy exists in normal cells, the question can be phrased in the following terms: does the DNA of a malignant cell contain virus-related sequences that are not found in the DNA of its normal counterpart? Phrasing the issue in this manner leads to the design of experiments that avoid the uncertainties generated by the demonstrated fact that many indigenous RNA tumor viruses share, completely or partially, some sequences with the normal DNA of their natural hosts (32). The crucial point is of course whether all of the viral sequences are to be found in normal DNA. The approach we adopted requires removal of those viral sequences that are contained in non-neoplastic DNA by exhaustive hybridization of the viral probe to normal DNA in vast excess. Any unhybridized residue can then be used to determine whether malignant DNA contains virus-related sequences not detectable in normal tissue.

We first investigated this question in the case of the human leukemias (6) and the strategy, as diagrammed in figure 6 (*A* and *B*), may be outlined in the following steps:

a) Isolate from leukemic cells the fraction enriched for the particles encapsulating the 70S RNA and RNA-directed DNA polymerase.

b) Use this fraction to generate [^{3}H]DNA endogenously synthesized in the presence of high concentrations of actinomycin D to inhibit host and viral DNA-directed DNA synthesis.

c) Purify the [^{3}H]DNA by hydroxyapatite and Sephadex chromatography, care being exercised to remove by self-annealing and column chromatography all self-complementary material in the tritiated probe.

d) Use the resultant [^{3}H]DNA to detect complementary sequences in normal and leukemic leukocyte DNA.

e) If virus-related sequences are detected in *both*, remove those found in normal leukocytes by exhaustive hybridization to normal DNA.

f) Test the residue for specific hybridizability to leukemic DNA.

In carrying out the recycling and test hybridizations, it is imperative that conditions be chosen to allow for the possibility that the leukemia-specific sequences are present in only one copy per genome, a possibility which is in fact realized (6). To this purpose, the concentration in moles per liter (C_o) of DNA and the time (t in seconds) of annealing is adjusted to C_ot values of 10,000, which are adequate to locate unique sequences.

A typical outcome of hybridizing such recycled tritiated DNA to normal and leukemic DNA is shown in figure 7. It is evident that no complexes stable at temperatures above 88° are formed with normal DNA. On the other hand, 57 per cent of the recycled [^{3}H]DNA probe forms well-paired duplexes with leukemic DNA. A series of such experiments was performed with particle-generated [^{3}H]DNA and nuclear DNA obtained from 8 untreated patients with either acute or chronic myelogenous leukemia. In every

TABLE 5

EXHAUSTIVE HYBRIDIZATION OF [^{3}H]DNA PROBE SYNTHESIZED BY LEUKEMIC PARTICLES WITH NORMAL-LEUKOCYTE NUCLEAR DNA, FOLLOWED BY HYBRIDIZATION OF THE NONHYBRIDIZING RECYCLED LEUKEMIC [^{3}H]DNA PROBE TO NORMAL DNA AND TO LEUKOCYTE NUCLEAR DNA FROM THE SAME LEUKEMIC PATIENT (6)

	Leukemic [^{3}H]DNA hybridized to normal-leukocyte DNA		Recycled leukemic [^{3}H]DNA hybridized to leukocyte DNA			
			Leukemic		Normal	
	cpm	% Hybridization	cpm	% Hybridization	cpm	% Hybridization
Ne (AML)	3,020	61	523	56	0	0
Ha (CML)	1,350	40	1,020	51	0	0
Co (CML)	2,580	51	431	35	3	0
Mi (CML)	510	45	101	36	0	0
Go (AML)	1,100	43	303	48	4	0
Si (AML)	4,520	49	1,130	46	1	0
El (AML)	390	42	45	69	0	0
Mac (AML)	1,450	49	510	52	0	0

Background was 30 cpm and all counts recorded represent cpm above background. CML = Chronic myelogenous leukemia. AML = Acute myelogenous leukemia.

case (table 5), the [^{3}H]DNA, after being subjected to exhaustive annealing to normal DNA, yielded a residue that forms stable duplexes only with leukemic DNA, in agreement with the experiment in figure 7.

In estimating the implication of this result, it must be recalled that the leukemia-specific sequences found (6) in leukemic cells are present as nonreiterated copies per genome. This was established by the C_0t values (concentration of nucleotides × time) required to detect them. The sensitivity used to examine normal cells for the leukemia-specific sequences was such that 1/50 of an equivalent of that found in leukemic cells would have been readily detected. Consequently, one may conclude that the vast majority of normal cells do not contain this particular stretch of malignant information and it cannot therefore be represented in the germ line of nonleukemic individuals.

UNIQUE SEQUENCES IN HODGKIN'S AND BURKITT'S LYMPHOMAS AND THEIR RELATEDNESS

We have already noted that, like the leukemias, Hodgkin's and Burkitt's lymphomas have particles containing reverse transcriptase and a 70S RNA template related in sequence to that of RLV. It was of obvious interest to determine whether the lymphomas also parallel the leukemias in possessing a unique sequence not detectable in normal tissue. If they do, one can in addition ascertain whether the sequences found in Hodgkin's and Burkitt's lymphomas are related to each other. The outcome has evident significance for the relevance of the sequence to malignancy.

[^{3}H]DNA probes were synthesized with particles isolated from four Burkitt's tumors and three Hodgkin's disease specimens. Sequences shared with normal DNA (between 35 and 40 per cent) were then removed as described for the leukemias (6) to yield the recycled [^{3}H]DNA probes (26).

Figure 8 shows the outcome of challenging recycled Hodgkin's disease [^{3}H]DNA with nuclear DNA from normal spleen, Hodgkin's disease spleen, and from Burkitt's lymphoma. Few, if any, stable duplexes are formed with normal DNA. Note, however, that although the probe was made with Hodgkin's disease particles, the [^{3}H]DNA hybridized to Burkitt's lymphoma nuclear DNA virtually as well as it complexed to DNA from Hodgkin's spleen. The converse is also true, as may be seen from table 6, which summarizes the results of our findings in the recycled [^{3}H]DNA challenged with nuclear DNA from normal and malignant tissues (26). Again, normal DNA is unable to form significant amounts of stable complexes (elution at 88° C and above) with the [^{3}H]DNA probes. In all instances, the lymphoma [^{3}H]DNAs hybridized in stable complexes to the nuclear DNA of the original types from which the particles were obtained and used to generate the labeled DNA. Further, with only one exception, all of the Burkitt's and Hodgkin's disease [^{3}H]DNA cross-hybridize with each other's DNA.

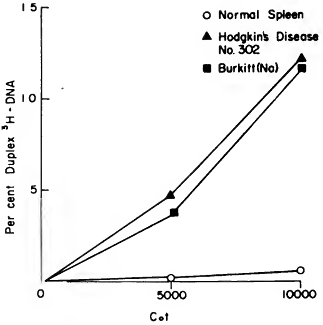

FIG. 8. Hybridization of recycled Hodgkin's disease #302 [^{3}H]DNA to nuclear DNA isolated from normal spleen (○---○), Hodgkin's disease #302 (▲—▲), and Burkitt's lymphoma (Na) (■—■). Equal aliquots were removed from the hybridization vessel at each C_ot value and hybrid formation was analyzed by hydroxyapatite chromatography. The input counts for each point were 1,500–2,000 cpm and only those duplexes eluting at 88° and above are counted as stably hybridized.

In summary, several features emerged from this study of the lymphomas. The particle-related sequences found in Burkitt's and Hodgkin's lymphomas possess sequences in common, an observation in accord with our earlier findings (19, 24, 25, 39), that Hodgkin's and Burkitt's particles both share sequences with the Rauscher murine leukemia agent. Further, in view of the previous association of the Epstein-Barr virus with Burkitt's lymphoma (20, 44) and the non-neoplastic infectious mononucleosis (21, 30), it is revealing to note from table 6 that the leukocyte DNA of patients with infectious mononucleosis was devoid of the Burkitt's sequences detected by the recycled [^{3}H]DNA probe, indicating that these latter sequences are specific for neoplastic tissues. The fact that the particle-related sequences in Hodgkin's and Burkitt's tumors are related to each other adds further weight to this conclusion. Finally, the observation that cells carrying multiple copies of the DNA of the Epstein-Barr virus do not complex with recycled [^{3}H]DNA probes from either Hodgkin's or Burkitt's particles proves that these particle sequences have no relation to the DNA of the Epstein-Barr virus.

EVIDENCE FROM STUDIES OF IDENTICAL TWINS

Although the comparison of leukemic patients with normals suggests that healthy individuals do not contain the leukemia-specific sequences, the data do not rule out the possibility that those who do come down with the disease do so because they in fact inherit the required information in their germ line. One way to resolve this issue is to study the situation in identical twins. Since identical twins are monozygous, i.e., derive their genomes from the same fertilized egg, any chromosomally transmitted information must be present in both. It had already been shown by Goh and his colleagues (12, 13) in the case of chronic myelogenous leukemia that only the leukemic member of each of two identical twin pairs contained the marker Philadelphia chromosome. It was of obvious interest to examine this situation for the leukemia-specific sequences. If the leukemic member of the pair contains the

TABLE 6

HYBRIDIZATION OF RECYCLED [^{3}H]DNA PROBES SYNTHESIZED WITH HUMAN LYMPHOMA PARTICLES WITH NUCLEAR DNA FROM NORMAL AND TUMOR TISSUES

Origin of [^{3}H]DNA recycled probe	Nuclear DNA	No. tested positive total	Percent positives
Burkitt's lymphomas	Burkitt's	7/7	100
	Hodgkin's	2/2	100
	Normal (spleen)	0/4	0
	IM* (spleen)	0/1	0
	IM* (cell)	0/1	0
Hodgkin's disease	Hodgkin's	3/3	100
	Burkitt's	2/3	67
	Normal (spleen)	0/3	0

* IM = infectious mononucleosis

particle-related DNA sequences, and does so because he inherited them through his germ line, then these same sequences must be found in the leukocyte DNA of his healthy sibling. To perform the experiment, it was necessary to locate identical twins with completely convincing evidence for monozygosity and where only one of them was leukemic. Further, the twins had to be of adult age since at least a unit of whole blood is required to provide enough leukocyte DNA to carry out the required hybridization.

Two sets of identical twins satisfying all these requirements were found and an experiment similar to the one outlined above was performed with each pair (7). In each instance, particles containing the reverse transcriptase and 70S RNA were again isolated from the leukocytes of the leukemic members and used to generate the [^{3}H]DNA endogenously. The [^{3}H]DNA was purified and sequences shared with normal DNA removed by exhaustive hybridization in the presence of a vast excess of normal DNA from random healthy blood donors. This was then followed by hydroxyapatite chromatography to separate paired from unpaired [^{3}H]DNA. It is important to emphasize that in the recycling step, the normal DNA used came from the leukocytes of healthy, random blood donors and not from the normal twin. To have used the latter would have obviously confused the issue. The residue of the tritiated DNA that did not pair with the normal DNA was then used to test for the presence of a sequence in the leukocyte DNA of the patient and that of his healthy sibling.

The results obtained with the two sets of twins are described in figure 9 and it is evident that the same situations holds between the members of the twin pairs as was observed in the comparison of unrelated leukemic patients and random normals (fig. 7 and table 5). The leukemic twin contains particle-related sequences that cannot be detected in the leukocytes of his healthy sibling.

The fact that we could establish a sequence difference between identical twins implies that the additional information found in the DNA of the leukemic members was inserted after zygote formation. This finding argues against the applicability of the virogene hypothesis to this disease since it would demand that the leukemia-specific sequences found in the DNA of the individual with the disease must surely also exist in the genome of his identical twin. These results are also inconsistent with the possibility that in-

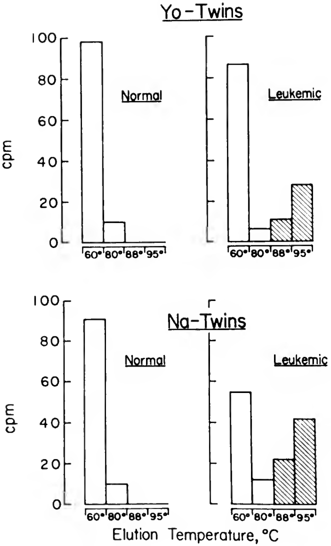

FIG. 9. Hydroxyapatite elution profile of a hybridization reaction of the recycled leukemic twin [^{3}H]DNA probe to nuclear DNA from normal leukocytes, normal twin leukocytes, and leukocytes from the same leukemic twin. The annealing reaction mixtures contained 20 A_{260} units of cellular DNA, 0.004 pmol of [^{3}H]DNA, and 15 µmol NaH$_2$PO$_4$ (pH 7.2) in a final vol of 0.01 ml. The reaction was brought to 98° for 60 sec and 0.04 mmol of NaCl was added. The reaction mixture was then incubated at 60° × 50 hr. The reaction was stopped by the addition of 1 ml of 0.05 M NaH$_2$PO$_4$ (pH 6.8). The sample was then passed over a column of hydroxyapatite of 20-ml-bed vol at 60°. The column was washed with 40 ml of 0.15 M NaH PO$_4$ (pH 6.8) at 60°, 80°, 88°, and 95°. Fractions of 4 ml were collected, the A_{260} of each fraction was read, and the DNA was precipitated with 2 µg/ml of carrier yeast RNA and 10 per cent trichloroacetic acid. The precipitate was collected on Millipore filters, which were dried and counted. In all cases, greater than 80 per cent of the nuclear DNA reannealed. A background count of 8 cpm was subtracted in all instances (7).

dividuals who succumb to leukemia do so because they inherit the complete viral genome.

PRESENT STATUS AND FUTURE PROSPECTS

We have summarized here experiments indicating that human breast cancers and mesenchymal tumors contain particulate entities possessing several of the diagnostic features of the RNA tumor viruses. In addition to size and density, these include the presence of a 70S RNA molecule encapsulated in an internal core with an enzyme, reverse transcriptase, that can employ the RNA as a template to make a DNA copy. Further, the particulate RNAs of the leukemias, lymphomas, and sarcomas are related in sequence to each other. The particulate RNA of human breast cancer possesses a unique sequence unrelated to those found in the mesenchymal tumors.

The fact that the human particles possess sequence homology to similar agents known to cause the corresponding neoplasias in mice encourages the hope that they are relevant to the human disease. However, despite the considerable progress that can be recorded, no definitive proof exists at the present writing that the virus-like particles found in the human neoplasias are either viruses or etiologic agents of the cancers in which they are found. Proof will ultimately come if it proves possible to produce the relevant malignancy in a susceptible animal by injection of particles purified from the human tumors. It should be noted, however, that we have known of the mouse mammary tumor virus for more than thirty-five years and no one has succeeded in producing mammary tumors with this agent in any animal, other than the mouse.

Under the circumstances, it would seem prudent not to wait for the definitive experiment with the human particles but rather to proceed with attempts at further exploration of their significance and possible clinical usefulness.

One important step forward would be accomplished by establishing particle-producing human tumor cells in short, or preferably, long-term culture. That this advance is in fact on its way is suggested by a number of recent reports. Thus, McGrath *et al.* (29) describe a human breast carcinoma cell line that may be a source of breast cancer particles. Kotler *et al.* (22) have succeeded in inducing the release of viruslike particles from human leukemic cells by arginine starvation. Mak and his colleagues (12, 13) have been setting up short-term cultures of leukemic bone marrow aspirates in a conditioned medium and finding particles in the tissue culture fluid. Finally, and most recently, Gallagher and Gallo (10) have reported what appears to be a highly productive line established from a patient with acute myelogenous leukemia. The particles produced appear to have some antigenic relation to the simian sarcoma agent (36).

All attempts to establish productive long-term cultures are always exposed to the all-pervasive danger of contamination with known animal oncornaviruses. Because of this, any evidence that the agent produced is either identical or even similar to a known animal oncornavirus has been accepted as sufficient evidence to condemn the culture and its particle as irrelevant to the human disease. It is important to recognize, however, that this is not a conclusive argument. For example, it could well be true that a virus found initially in a non-human primate may have originally come from a human source. It is also not safe to conclude that an agent is human if it cannot be identified by either base sequence or antigenic properties with a known animal virus. Quite clearly, until our catalog of all animal tumor viruses is complete, this line of reasoning has no compelling logical basis.

Is there at present any criterion that can be usefully used to decide whether a given tissue culture virus is in fact of possible relevance to human cancer? There is one possible answer to this question and it depends on the presence of unique virus-related sequences in the DNA of malignant cells. *If the DNA of the original tumor from which the culture was derived contains sequences found in the particles produced by the tissue culture, then contamination during cultivation can be eliminated.* If this condition is satisfied, the particle cannot be dismissed as an irrelevant contaminant no matter what its relation to known animal oncornaviruses.

One further comment can be made about the presence of unique sequences in malignant DNA. Their existence is clearly not consistent with any mechanism that does not involve the insertion of virus-related sequences into the DNA of a malignant cell. Again this does not mean that other mechanisms are not operating, but these cannot, in the face of such evidence, be the sole mechanism. Further, the identical twin data require the postzygotic insertion into the genome of the viral information, a process known to occur with RNA tumor viruses in animal cells both in tissue cultures (14) and in whole animals (40) under laboratory conditions.

It is evident that these findings suggest more optimistic pathways for the control of these diseases than would be available if the total information were already present in the genome. The data imply that in at least some cancers we may not be forced to master the control of our own genes in order to cope with these neoplasias. Finally, the existence of the leukemia-specific sequences can provide the clinician with a hitherto unsuspected parameter that could potentially be a useful adjunct in diagnosis and in monitoring therapy. Future efforts should attempt to extend these unique sequence differences to proteins for which they may well code. This would provide unique proteins as signals of the presence of the corresponding neoplasias and could open up the possibility of immunological approaches for both the diagnosis and the treatment of these diseases.

ACKNOWLEDGMENTS

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CANCER CELLS AND NORMAL CELLS

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(Read November 15, 1974, in the Symposium on New Approaches in the Study of Neoplasia)

This address is dedicated to the memory of Dr. Wendell M. Stanley, in whose institute I worked for twelve years. Dr. Stanley was a member of the American Philosophical Society; he once told me that of all the honorary societies to which he belonged he considered the American Philosophical Society preeminent. Dr. Stanley was keenly interested in the relation between viruses and cancer. He strongly advocated, many years ago, a relationship between the two.

CANCER is like the elephant that, in an Indian tale, is observed by a group of blind men; each man feels one part and takes it for the whole beast. For my part, I consider the entire beast is represented by a cell that has gone wrong. I should say first that we living beings are each made of many cells, perhaps one hundred million-million cells apiece. Each cell has a diameter about 1/100 that of a pinhead. Nearly a million cells would fit into the space of the pinhead. Seen at very great magnification with the electron microscope, they have a definite structure, both outside and inside. They contain various smaller bodies, such as the nucleus, in which the genetic material is stored and the mitochondria which provide energy. There is all the more wonder at the fineness of architecture of the cell when we think about its minute size.

We see cancers as masses of tissue. But cancer is really a cellular disease, based on a single cell that went wrong. A cancer mass in an animal is generally totally derived from a single cell. That is, all of the cells in the cancer have properties that are similar, and they must have arisen from many divisions of a single initial cell. We would like very much to know what was different about that original cancer cell. What changed its growth properties and allowed it to escape from the controls that keep normal cells in line?

Normal cells grow and die in balance with the rest of our bodies, when we are adults. Certain kinds of cells are found in definite places, and generally cells do not move randomly to other parts of the body. By contrast, a cancer cell reproduces and develops into a population of cells. It increases to exceed the appropriate, normal number of cells for the organ in which it originates. Cancer cells can metastasize—break away from their cell mass and settle into other parts of the body. And the metastasizing cells can grow in these new locations that are inappropriate for the metastasizing type of cell. Thus, we find cancer cells growing among normal cells and invading and disrupting orderly population (fig. 1).

We assume that there must be some biochemical difference that is responsible, that makes a cancer cell behave differently from a normal cell. The cells look much the same. So we must seek this difference at the subcellular, more chemical level. Many scientists have for years sought a cellular difference, any difference, without success. Now a number of such differences are being found. Most of them turn out to be at the cell's surface, that is, in the membrane surrounding the cell, acting as a barrier to the outside world, holding together the cell's constituents on the one hand, and preventing many materials that are harmful from entering the cell on the other. But also the membrane must allow transport into the cell's interior of nutrients and other necessary materials, and exit from the cell of waste products. Transport across the cell membrane is thus highly selective.

I will briefly describe three differences between normal cells and cancer cells. First, however, a comment is needed regarding a very important

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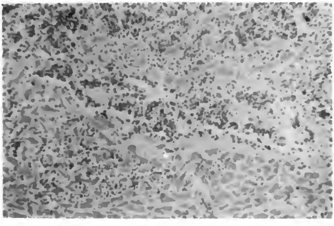

FIG. 1. Heart tissue invaded by cancer cells of striated muscle type. The heart tissue is made up of pale, larger cells, and the cancer of small, darker cells. (Photograph courtesy of Dr. Emil Frei, III.)

method that allows us to find these differences between cell types. In the study of living systems it is very useful to obtain the simplest possible experimental material. In this case we want to let cells grow alone, away from the total animal. Thus a host of conditions that we do not understand and cannot control is eliminated. We can then look at the cell and manipulate it in a much more direct manner. One now can grow animal cells in isolation, by what is known as tissue culture. If we take a small sample of tissue and place it on a glass or plastic surface, and then cover it with a nutrient solution to provide the food that cells need, and then incubate the culture at body temperature, we find that cells will grow. They generally grow upon the solid surface, to which they adhere; there they proceed to go through divisions and produce more cells.

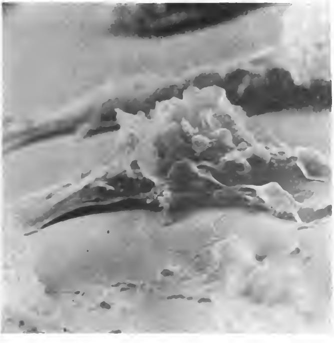

FIG. 2. A thymus cancer cell (thymoma) growing in tissue culture. (Scanning electron micrograph courtesy of Dr. Keith Porter.)

Some kinds of cancer cells and some kinds of normal cells can be grown in culture (fig. 2). The cells change their properties while they are cultured; but many useful properties remain (Stoker, 1972). In particular, cells can remain sensitive to drugs that kill cancer cells in the animal. Patterns of growth of normal and cancer cells in culture are different (fig. 3). The normal cells grow until they cover the solid surface as a sheet only one cell thick. Then they stop growing. This is very much like the healing of a wound, in which the cells grow until they have filled up the cut and then stop. In contrast, cells that cause cancer in animals continue to grow beyond a monolayer, and pile up on one another. They give the appearance of being unaware of each other, growing in a helter-skelter fashion, crossing and piling up in a disorderly way. Thus, cancer cells seem to have lost their ability to interact and to be controlled by the presence of their neighbors.

One useful technique for studying normal and cancer cells is to change the former into the latter by what is called transformation. A number of viruses that cause cancer in animals also can transform cells in culture. When these viruses are added to normal cells, striking changes appear in a number of cell properties. Growth starts up

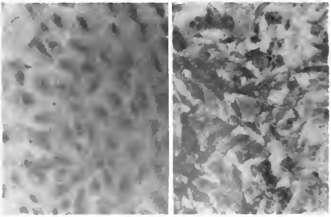

FIG. 3. Growth of cell populations in tissue culture. The cells to the left are 3T3 noncancerous mouse fibroblasts (connective tissue cells). Those at the right are cancerous fibroblasts that were obtained by transformation of the 3T3 cells with polyoma virus.

a day or so after infection. Before that time there is an increase in the synthesis of the genetic material, DNA. But even earlier, several surface changes can be found. Numerous fingerlike projections appear on the surface (Porter, Todaro, and Fonte, 1973). Second, various antigenic changes can be detected using the antibodies against tumor cells that do not interact with normal cells. A third very interesting early change has to do with increased transport of molecules across the cell membrane. It should be stressed that these are the earliest known alterations in the cell following transformation to the cancerous condition.

Changes in transport following transformation either by viruses or by chemicals that cause cancer in the animal (carcinogens) have been observed for many kinds of cells and in many laboratories (fig. 4). These changes bring about more rapid uptake of a number of compounds that are important for cell growth, including sugars, amino acids, inorganic materials such as phosphate, and compounds that are built into the nucleic acids (Foster and Pardee, 1969). Some think that these increased rates of transport can provide better nutrition for cancer cells, and that this is the basic reason for their more rapid growth.

A second type of change that occurs after transformation is the increased ability of plant proteins called lectins to make the cells clump together (Burger, 1969). Normal cells in suspension are not clumped into masses of cells by small concentrations of these lectins. However, shortly after transformation, the cells change so that the same concentration of lectin that was previously ineffective now causes the cells to clump together. These lectins are attached to the cell surface, and thus this result suggests some alterations of the properties of the cell surface. It was originally thought that transformation resulted in production of new chemical groups on the cell's surface that allowed more of the lectin molecules to attach than previously. Now, however, it seems that the surface change that is responsible for cell clumping is increased ability of the bound lectins to slide about on the cell surface and to collect in clumps which cooperate in attaching cells to one another. In any event, the lectins have indicated to us a dramatic change in cell-surface properties.

A third, quite recent and very intriguing observation, is that many cancer cells, but not normal cells, secrete an enzyme that digests proteins (Reich, 1974). Enzymes of this sort are called proteases. These proteases can alter the properties of the cells that produce them, and also the properties of nearby normal cells, by attacking the cell surface proteins. What importance such enzymes have in altering the cell surface and in affecting nearby cells so as to modify their interaction with the cancer cells is being vigorously investigated at present.

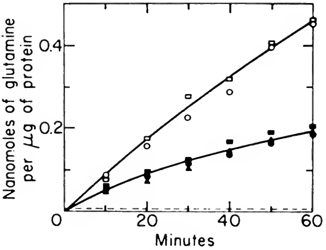

FIG. 4. Rates of transport of the amino acid glutamine into virus transformed 3T3 cells (open symbols) and untransformed 3T3 cells (closed symbols).

Many agents added from outside a cell can determine the growth state of the cell. Some of these agents, such as insulin and various proteins in the serum that is added to permit cell growth, are acting at the cell surface. These agents can convert the cells from a quiescent, resting state to a growing, proliferating state. When the agents, or essential nutrients, are removed, the cells are shifted back into the quiescent state (Tobey and Ley, 1971). Normal cells can exist, apparently happily, in these alternative states of quiescence or proliferation. This is also true of the cells in our bodies. Our brain cells are not dividing at all rapidly; but in contrast skin and intestine cells are dividing continually, as are cells in the bone marrow. Existence of these two states of normal cells raises questions as to how, when, and where the decision is made as to the state in which a cell shall exist (Pardee, Jiménez de Asúa, and Rozengurt, 1974). We ask, also, whether this control of cell-growth state is modified in cancer cells in such a way that the cancer cells have a greater tendency to be in the proliferating state. Many cancer cells in culture appear not to need the stimuli from outside that activate growth of normal cells.

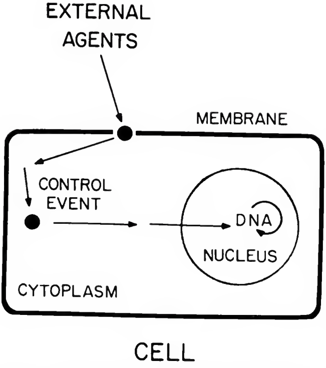

FIG. 5. Transmission of regulatory signals from the outside to the nucleus of a cell (schematic diagram).

Following the surface events just described, the next event to show that cells are commencing to grow is replication of the genetic material, the DNA, which is deep inside within the cell nucleus. An important problem is the means by which a message or signal can be sent from the cell surface to the nucleus, to tell it when to start DNA synthesis (fig. 5). This message presumably travels through the intervening cell sap or cytoplasm by biochemical means. I have proposed that this passage involves a special biochemical reaction that depends upon the outside stimulus and that responds by permitting the nucleus to start replicating its DNA (Pardee, 1974). This event has been named the "restriction point," and evidence is being sought about its properties.

I can only touch on the kinds of experiments which are being used to probe this proposed restriction-point control, and its alteration in cancer cells. The event that starts up DNA synthesis occurs for the cell as a whole (Fournier and Pardee, 1975). If cells are manipulated so that two nuclei are found in the same cell, both start up their DNA synthesis at the same time (fig. 6). This indicates that some change has occurred, most likely in the cytoplasm, that is sensed by both nuclei. Furthermore, DNA synthesis starts up earlier in the cells with two nuclei than it does in cells with only one nucleus. There must be some cooperation between the two nuclei to allow them to go into action faster than does either one alone. Both of these observations suggest that there is a diffusible material in the cytoplasm surrounding these nuclei that keeps them informed of the growth state of the cell. If we could learn about the nature of this substance which is capable of starting DNA synthesis, and about the biochemical mechanism it affects and thereafter allows cell division, we would know a great deal more about what is necessary for a cell to grow normally or abnormally.

The second observation is that in normal cells release from the restriction of growth starts at the same point in time in the normal cell-growth cycle, irrespective of how the cells were stopped and restarted. Animal cells go through a cyclic succession of events (fig. 7) starting with cell division, progressing through a period called G1 in which many molecules including enzymes are synthesized, then into a period called S during which DNA is being made, then into another period of protein synthesis called G2, and finally the changes of the cell nucleus that prepare the cell for division occur in the rather brief period called M, mitosis. After this, the cell divides. When cells are stopped by normal, physiological means, they halt in the G1 part of the cell cycle. When they start up again they all require the same length of time before DNA is made, irrespective of how they were stopped (fig. 8). Furthermore, if cells are stopped by one means and we then try to start them up by imposing another condition that leads to quiescence, the

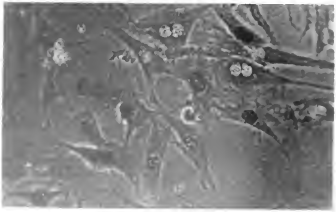

FIG. 6. DNA replication in mono and binucleate cells. Baby hamster kidney cells were allowed to take up radioactive thymidine (a compound that is incorporated into DNA when the DNA replicates). The nuclei of cells that were making DNA at the time of addition of thymidine are dark; those that were not making DNA are light.

cells do not proceed on through the cycle. This result is seen irrespective of whether the two conditions are applied in succession, or their order of application. This result suggests very strongly that both blocking conditions are acting at the same point; otherwise if one condition arrested the cells before the other one did, then under one sequence or the other when the cells escaped from the first-applied restriction they would already be beyond the second restriction and would therefore go on to make DNA. Since we do not observe this sort of escape, we conclude that the restrictions are acting at the same point. These and other results suggest that normal cells have a very special event in their cycle, an event designed to put them into a quiescent state when physiological growth conditions become unfavorable, and to keep them healthy under these conditions.

A few experiments suggest that this restriction-point control may be defective in tumor cells (Pardee, 1974; Paul, 1973). When tumor cells are treated in the same way, by means that stop the growth of normal cells, they eventually stop growing. However, they do not stop at a definite place in the cell cycle but they stop at random points as if they had simply randomly run out of a necessary nutrient. This result suggests that the restriction-point control is damaged in the tumor cells. Furthermore, if we try to restart growth of these tumor cells by adding back all of the needed nutrients to the starved cells, growth does not restart. The cells have been killed by starvation. This is a contrast to the readily restarted normal cells. Such a difference subsequent to starvation might be basic to some of the methods used in chemotherapy and the selective killing of tumor cells. For once, tumor cells have greater sensitivity than do normal cells.

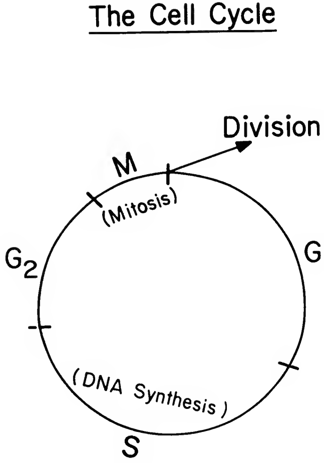

FIG. 7. The cell division cycle.

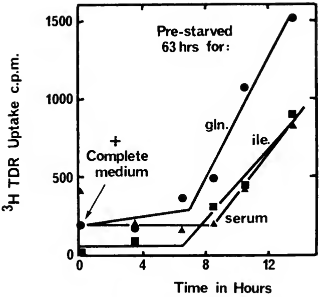

FIG. 8. Restarting DNA synthesis after cells have been stopped by various starvations. Three separate cultures of baby hamster kidney cells were deprived of serum, glutamine, or isoleucine (another essential amino acid) for 63 hours. Then they were put back into complete nutrient medium again, and their ability to incorporate thymidine was determined, as a measure of their ability to make DNA and restart growth.

We do not yet know the biological significance or the usefulness of the differences that I have described to you. The differences could be useful because other, biochemically unknown differences permit some chemicals to kill cancer cells selectively; that is, they kill cancer cells but are much less lethal to any of the many normal cell types in our bodies. There must be significant, useful differences that will help us cure cancers. Our job is to discover them.

In science, we first create fantasies, and then we try to discover whether they are merely dreams.

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CELL-MEDIATED IMMUNITY TO TUMOR ANTIGENS AS STUDIED *IN VITRO*

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(Read November 15, 1974, in the Symposium on New Approaches in the Study of Neoplasia)

INTRODUCTION

It has been well established that experimentally induced animal tumors have tumor-specific antigens.[1-3] These antigens can be detected with a variety of techniques. One can show that animals immunized against syngenic tumors (i.e., tumors originating within the same inbred strain) often reject transplants of the respective neoplasm, and one can detect both lymphocyte-mediated immune reactions and humoral antibodies against many tumors. Although the evidence for tumor immunity in man is more indirect, many human neoplasms appear to possess tumor antigens reacted against by the tumor-bearing patients.[2]

Cell-mediated immune reactions are believed to play a major role in the rejection of antigenic tumors.[2] This view is based on several sources of evidence. First, tumor-specific immune reactions can be adoptively transferred with lymphocytes from immune animals to non-immune, syngenic recipients, while transfer with serum works only occasionally. Second, lymphocytes from properly immunized animals will prevent the outgrowth of tumor cells in a syngenic host when admixed with them. Third, lymphocytes from immune donors can kill or prevent growth of tumor cells *in vitro*.

Factors present in serum are able to influence tumor growth, as shown by studies performed both *in vitro* and *in vivo*.[2] Sera from tumor-bearing (and sometimes also from tumor-immunized) animals have been shown to facilitate the growth of transplanted tumors *in vivo*, a phenomenon often referred to as immunological enhancement. The same sera can often block (inhibit) the killing of neoplastic cells by specifically sensitized lymphocytes *in vitro*. Under other circumstances, however, serum factors may act antagonistically to the tumor.[2] Serum antibodies can have a direct cytotoxic effect in the presence of complement. They can also act as lymphocyte-dependent antibodies, allowing lymphocytes from non-sensitized hosts to kill tumor cells. Furthermore, tumor antibodies can be "unblocking," i.e., they can prevent the inhibition of specific tumor cell-mediated immune reactions by tumor-bearer serum.

It is thus apparent that the interaction between a growing tumor and its host is complex, involving cellular and humoral immune mechanisms, which can both facilitate and inhibit tumor growth. This complexity is further increased by the fact that most tumor cells have a number of different tumor-specific or tumor-associated antigens and that the host may react in different ways to the different antigens. Furthermore, different aspects of the host defense will be observed, dependent on what techniques are used. For such reasons, it is a difficult task to establish certain principles concerning the immune response of a host to its growing neoplasm. Keeping this reservation in mind, we shall try to discuss some facets of this immune response, as observed in animals with growing neoplasms *in vivo*. We shall also take up work of a similar nature performed in human cancer patients. Our coverage of the subject will be fairly general; the reader is referred to a recent review article [2] for details and for most of the references to the original work.

METHODOLOGY

The work described in this article is primarily based on studies performed with the microcytotoxicity test.[4, 5] This test measures the com-

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[1] R. W. Baldwin, "Immunological Aspects of Chemical Carcinogenesis" *Advanc. Cancer Res.* **18** (1973): pp. 1–75.

[2] K. E. Hellström and I. Hellström, "Lymphocyte Mediated Cytotoxicity and Blocking Serum Activity to Tumor Antigens," *Advanc. Immunol.* **18** (1974): pp. 209–277.

[3] G. Klein, "Tumor Immunology," *Transplant. Proc.* **5** (1973): pp. 31–41.

[4] M. Takasui and E. Klein, "A Microassay for Cell-mediated Immunity," *Transplantation* **9** (1970): pp. 219–227.

[5] I. Hellström and K. E. Hellström, "Colony Inhibition and Cytotoxic Assays," in: B. R. Bloom and P. R. Glade (eds.), *In Vitro Methods in Cell-mediated Immunity* (New York, Academic Press, 1971), pp. 409–414.

bined effect of the killing of tumor cells by appropriately sensitized lymphocytes and prevention of their growth *in vitro*. The cytotoxic and growth-inhibiting effects are generally measured by visually counting the number of tumor cells which remain attached to a plastic surface following exposure to immune, as compared to control, lymphocytes. It is also possible to label the tumor cells and thus better distinguish a cytotoxic lymphocyte effect from a cytostatic one.

Before the microcytotoxicity assay was introduced, a colony inhibition test had been in use for a few years. That test measures the ability of plated tumor cells to form colonies *in vitro*.[5] Although the colony inhibition technique appears to be more sensitive than the microcytotoxicity assay, the latter is now preferred because it is technically simpler.

Instead of measuring an effect of lymphocytes on the target cell, one can measure the effect on the lymphocytes by their exposure to appropriate tumor antigens.[2] Doing that, it has been shown that lymphocytes from tumor-sensitized animals, or human patients, will transform into lymphoblasts, as measured by an increased DNA synthesis, upon exposure *in vitro* to appropriate tumor antigens.[6, 7] It has also been demonstrated that, upon contact with specific antigens, lymphocytes from immune donors produce lymphokines which can inhibit the migration of macrophages out of glass capillary tubes.[8]

The information obtained with various techniques differs to some extent.[2] Thus tumor-bearer serum can block the cytotoxic effect of sensitized lymphocytes, while sera from tumor-immune donors rarely block when so tested (see below). The latter type of serum will, however, often inhibit the transformation of lymphocytes to lymphoblasts. On the other hand, there is a fairly good correlation between findings obtained by the microcytotoxicity assay and by assays for inhibition of macrophage migration.[2]

We shall now discuss some of the major findings obtained when studying cell-mediated reactivity to tumor target cells *in vitro*.

RESULTS AND DISCUSSION

(*a*) *Cell-mediated reactivity of lymphocytes of tumor-immune and tumor-bearing animals, as detected by the microcytotoxicity test:*

Lymphocytes from animals which have been immunized by being transplanted with tumor tissue after which the tumors were surgically removed, will kill cells from the respective neoplasm *in vitro*, as detected by the microcytotoxicity assay, and they will inhibit the outgrowth of tumor cells *in vivo* when mixed with them and inoculated into syngenic hosts.[2] Such immune lymphocytes will also produce lymphokines which inhibit the migration of macrophages out of capillary tubes.[8] The reactivity detected *in vitro* often agrees with reactivity detected by transplantation tests *in vivo*. For example, chemically induced sarcomas in mice have exhibited a similar antigenicity when tested by transplantation techniques and by microcytotoxicity assays.[8]

It was found, somewhat surprisingly, some seven years ago, that lymphocytes from animals bearing growing tumors are also cytotoxic to cells from the respective tumors cultivated *in vitro*. In some systems, these cytotoxic effects have been as high as seen in animals whose tumors have been removed and which have a tumor-specific transplantation resistance.[2] In other systems, only a weak tumor-specific reactivity is generally detected *in vitro*, when lymphocytes from tumor-bearing animals are used, and there are a few systems where no reactivity at all is detected with such lymphocytes.[2]

It is more difficult to perform clear-cut experiments with human tumors than with animal neoplasms, since the findings made with human neoplasms are complicated by immune reactions to normally occurring alloantigens. In spite of these difficulties, data have been obtained from work with microcytotoxicity tests, macrophage migration inhibition assays, and tests for lymphocyte transformation, indicating that immune responses to human neoplasms do occur and are mediated by lymphocytes from patients having a particular type of tumor.[2] A major difference between the human studies and most of those performed in animals is (as will be discussed below) that human tumors of the same histological type often cross-react; the cross-reactivity

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[6] F. Vanky, J. Stjernswärd, G. Klein and V. Nilsonne, "Serum-mediated Inhibition of Lymphocyte Stimulation by Autochthonous Human Tumors," *Jour. Nat. Cancer Inst.* **47** (1971): pp. 95–103.

[7] J. T. Forbes, Y. Wakao and R. T. Smith, "Tumor-specific immunity to chemically induced tumors. Evidence for immunologic specificity and shared antigenicity in lymphocyte responses to soluble tumor antigens," *Jour. Exp. Med.* **141** (1975): pp. 1181–1200.

[8] W. J. Halliday, "Macrophage Migration Inhibition With Mouse Tumor Antigens: Properties of Serum and Peritoneal Cells During Tumor Growth and After Tumor Loss," *Cell. Immunol.* **3** (1972): pp. 113–122.

seen with most animal neoplasms has been of a different nature, cross-reactions being detected primarily between tumors of a common, viral etiology.[2]

(*b*) *Blocking of tumor-specific immune reactions by serum from tumor-bearers:*

The fact that tumor-specific immune reaction can be detected in tumor-bearing hosts, even when the tumors grow progressively, seems puzzling. A variety of explanations for this has been considered, and probably more than one mechanism is contributory.[2]

One of the more important escape mechanisms of tumors from immunological control seems to be revealed by the finding that sera from tumor-bearers are capable of blocking (inhibiting) the specific lymphocyte-mediated immune response to a given tumor antigen.[2] This was first detected with mice bearing progressively growing Moloney sarcomas. Lymphocytes from such mice were found to kill Moloney sarcoma cells *in vitro,* and sera from animals with such tumors (progressors) could block this cytotoxic effect, while sera from mice whose tumors had regressed generally did not block. Likewise, sera from rabbits which had persistent Shope papillomas (and which lacked detectable reactivity to Shope papillomas *in vivo*), were found to block cell-mediated reactivity to cultivated Shope tumor cells. Later work extended these findings to a variety of other systems.[2]

The blocking effect of serum can be detected at both the target and the effector cell level.[1, 2] In the first case, it is assayed by incubating the target cells in the presence of tumor-bearer serum, after which the serum is removed, the target cells washed, and the lymphocytes added. In the second case, it is studied by incubating the effector cells with serum, washing them, and adding them to the target cells. The blocking effect detected at the effector cell level is, by some investigators, referred to as inhibition rather than blocking. Unless stated otherwise, in the experiments discussed in this article, sera have been routinely tested for blocking activity by being added to the mixture of effector and target cells.

Essentially three types of blocking molecules have been detected.[2] First, free, circulating tumor antigens, present in tumor-bearer serum or prepared from tumors, can inhibit the reactivity of effector cells when mixed with these; free antigen has no detectable blocking activity when studied at the target-cell level. Second, antibodies present in tumor-bearer serum, or taken from immunized animals, can block lymphocyte-mediated reactivity at the target-cell level. Third, a mixture of antigen and antibodies, probably in the form of antigen-antibody complexes, can block at both the effector and the target-cell levels.

Blocking by free antigen is often detected very early after tumor transplantation, while blocking by antigen-antibody complexes starts to be seen after about a week (R. W. Baldwin *et al.,* personal communication) and is then often detected over the remaining lifespan of the tumor-bearing host. Free antibodies, which block only at the target cell level, are sometimes detected in animals with very large tumors.

Little is known about the nature of the molecules involved in these reactions. There is evidence, however, that the antibody part of the blocking factor seen in tumor-bearing mice is often of the IgG2 variety (to be published). The exact nature of the circulating, free antigens and antigen-antibody complexes remains unknown. Since the blocking factors are generally detected in the 7S fraction of tumor-bearing serum,[2] it seems likely that the complexes are rather small.

(*c*) *"Unblocking":*

Sera from tumor-immunized donors can often cancel ("unblock") the blocking effect of sera from tumor-bearers.[2] The molecules responsible for this are immunoglobulins. They can be removed by absorption with the respective tumor cells. The unblocking effect is probably mediated by antibodies which bind to those antigens or antigen-antibody complexes which would otherwise have reacted with the effector cells.[2]

(*d*) *Lymphocyte-dependent antibodies:*

Some sera from tumor-immune donors, as well as some sera from tumor-bearers, can bestow a specific cytotoxic effect on lymphocytes from non-immunized donors.[2] The molecules responsible for this appear to be primarily IgG immunoglobulins and are generally referred to as lymphocyte-dependent antibodies (LDA). The effector cells with which they react lack the markers of thymus-derived lymphocytes; they are sometimes referred to as killer (K) cells.[2]

In some cases, sera from tumor-immune donors have been found to increase ("potentiate") the cytotoxic effect of lymphocytes derived from immune animals.[2] It is unclear whether the potentiating serum effect is caused by lymphocyte-dependent antibodies, or is more related to the unblocking phenomenon.

Antibodies with unblocking and/or LDA properties may provide useful tools for the prevention of tumor formation and for treatment of already existing tumors. Little work has been done to this end, however. There is evidence that inoculation of mice carrying growing Moloney sarcomas with unblocking serum can induce tumor regression,[9] and similar treatment of rats carrying growing primary or transplanted polyoma tumors with unblocking serum has been reported to have an immunotherapeutical effect.[10] However, the effects observed in these systems have been rather modest, even when very large amounts of serum have been given, and rarely affect more than 30 per cent of the treated animals. Furthermore, it is unclear to what extent the therapeutical effects have been due to an actual unblocking activity of the sera inoculated, to LDA antibodies, or to antibodies which are cytotoxic to tumor cells in the presence of complement. Whatever the case may be, these findings are still important because they indicate that serum antibodies may, under certain circumstances, be therapeutically beneficial.

(*e*) *Immunity to "tissue-type specific" tumor antigens:*

The reactivity pattern seen with human tumors is rather different from that generally encountered in animals. Thus, lymphocytes from human patients with a particular type of tumor, e.g., carcinoma of the colon, are generally cytotoxic to tumor cells of the same histological origin, while they lack cytotoxicity to tumor cells of other types or to normal cells of the respective tissue. The antigens involved in these reactions have been referred to as tissue-type specific tumor antigens.[2]

When these observations were first encountered, there were no similar experimental models in animals. At that time, the observed immunological reactivity against animal tumors had been of two types: tumors (particularly sarcomas) induced by chemicals had been found to have individually unique antigens, and tumors induced by viruses had been shown to cross-react, the cross-reactivity being determined by the respective tumor virus.

Bladder carcinomas are among those human neoplasms which have been most investigated immunologically. They have, indeed, common antigens, against which immune reactions can be detected by using lymphocytes from patients with bladder carcinomas.[11] For this reason, studies were begun in order to search for a similar reactivity pattern among bladder carcinomas induced in rats and mice. These studies showed that murine bladder tumors, in spite of the fact that they were chemically induced, cross-reacted within the respective animal species when tested *in vitro*.[12] Experiments were then performed, in a similar way, using chemically induced carcinomas of the colon instead.[13] These experiments showed that colonic carcinomas of rats behave similarly; they cross-react extensively, as detected by the microcytotoxicity assay, even when they are induced by different chemical agents.

Although murine bladder carcinomas cross-react when tested *in vitro,* their behavior *in vivo* is more complex. On the one hand, the chemical induction of primary bladder papillomas in rats has been delayed after immunization of rats with cells from a pool of bladder papilloma tissue.[12] On the other hand, cross-reactions were not detected when transplantation tests were performed in mice to search for such antigens against which reactivity would lead to rejection of grafted tumor cells in pre-immunized mice. Each bladder tumor was then found to immunize only against itself.[14]

The fact that the common tissue-type specific antigens of mouse bladder carcinomas do not appear to act as tumor-specific transplantation antigens may raise doubts as to the relevance of these antigens as targets for tumor destruction *in vivo*. It is, however, important to remember in this context the results from the prevention experiments in rats, and also the fact that immune reactions to tissue-type specific antigens in human tumors often correlate with the clinical course of patients.[2] Thus patients with growing tumors commonly possess blocking factors specific for the respective tumor, while patients who do not have clinical evidence of neoplasia following tumor removal do not generally have blocking sera, until clinical relapse impends.[15] These findings suggest that immune reactivity to common tissue-type specific tumor antigens can counteract tumor growth *in vivo,* although immunity to other antigens, perhaps individually unique ones, may be at least as important. If some ways could be found by which the former, common antigens could be made into strong tumor-specific transplantation antigens, something useful for tumor therapy would probably be learned.

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[9] I. Hellström, K. E. Hellström, G. E. Pierce and A. Fefer, "Studies on Immunity to Autochthonous Mouse Tumors," *Transplant. Proc.* **1** (1969) : pp. 90–94.

[10] S. C. Bansal and H. O. Sjögren, "Counteraction of the Blocking of Cell-mediated Tumor Immunity by Inoculation of Unblocking Sera and Splenectomy: Immunotherapeutical Effects on Primary Polyoma Tumors in Rats," *Int. Jour. Cancer* **9** (1972) : pp. 490–509.

[11] J. Bubenik, P. Perlmann, K. Helmstein and L. Moberger, "Cellular and Humoral Immune Responses to Urinary Bladder Carcinomas," *Int. Jour. Cancer* **5** (1970) : pp. 310–319.

[12] L. A. Taranger, W. H. Chapman, I. Hellström and K. E. Hellström, "Immunological Studies on Urinary Bladder Tumors of Rats and Mice," *Science* **176** (1972) : pp. 1337–1340.

[13] G. Steele, Jr. and J. O. Sjögren, "Cross-reacting Tumor Antigen(s) Among Chemically Induced Rat Colon Carcinomas," *Cancer Res.* **34** (1974) : pp. 1801–1807.

[14] D. V. Wahl, W. H. Chapman, I. Hellström and K. E. Hellström, "Transplantation Immunity to Individually Unique antigens of Chemically Induced Bladder Tumors in Mice," *Int. Jour. Cancer* **14** (1974) : pp. 114–121.

(*f*) *Embryonic antigens:*

Following pioneering work by Abelev, Gold, Coggins and others,[16] evidence has accumulated over the last few years that neoplastic cells have antigens which are also present in normal embryonic cells.

Work by Coggins suggested that some embryonic antigens may act as transplantation antigens *in vivo,*[16] and studies by Brawn showed that lymphocytes from multiparous mice can be cytotoxic to tumor cells when tested *in vitro* without affecting normal adult cells.[17] This indicated that (in addition to whatever individually unique and virus-determined antigens neoplastic cells may have) antigens which tumor cells possess in common with normal embryonic cells may, under appropriate conditions, act as targets for an immune response which can lead to tumor-cell destruction.

Using the microcytotoxicity assay, the cytotoxic effect of lymphocytes from multiparous mice has been found to be at approximately the same level as that seen with lymphocytes from appropriately immunized donors which show transplantation resistance *in vivo.*[18] In spite of this, there is no clear evidence that such *in vitro*-reactive lymphocytes from multiparous mice can reject tumor cells *in vivo.*[2]

There is thus a dilemma. Many hypotheses can be advanced to explain it. For example, one may argue that embryonic tumor antigens are not expressed *in vivo,* perhaps because they are distributed so scarcely at the target cell surface that a cytotoxic immune response will be detected only under the artificial condition of a great excess of lymphocytes over target cells *in vitro*. Another explanation is that the embryonic antigens are so loosely bound to the tumor cell surface that they will not stay sufficiently long there to function as targets for a cytotoxic response *in vivo*. One may also speculate that embryonic tumor antigens are particularly good blockers of cell-mediated cytotoxic reaction, perhaps by being more prone to detach from the cell surface, and that this is why they do not function as tumor-specific transplantation antigens.

During the past year we have undertaken a series of experiments to study this.[18, 19] First, we were able to confirm the findings of Brawn that lymphocytes from multiparous mice are cytotoxic to a variety of tumor cells *in vitro* while normal adult cells are generally not affected. This was particularly revealing when we used a 3T3 cell line, which does not behave like tumor cells *in vitro* and does not normally form tumors *in vivo,* comparing it with cell lines neoplastically transformed from 3T3, including one transformed by the Moloney sarcoma virus, one transformed by the SV40 virus, and one spontaneously transformed. We found that lymphocytes from multiparous mice were cytotoxic to all the transformed cell lines, while the nontransformed 3T3 line was not affected. Since all these cell lines had a common ancestry, we feel that the cytotoxic reactions observed were in some fashion related to the neoplastic behavior of the cells.

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[15] I. Hellström and K. E. Hellström, "Cell-mediated Immune Reaction to Tumor Antigens with Particular Emphasis on Immunity to Human Neoplasms," *Cancer* **34** (1974): pp. 1461–1468.

[16] *Proceedings of the First Conference and Workshop on Embryonic and Fetal Antigens in Cancer,* N. G. Anderson and J. H. Coggin, Jr., eds. (Oak Ridge National Laboratory, 1971).

[17] R. J. Brawn, "Possible Association of Embryonal Antigen(s) with Several Primary 3-Methylcholanthrene-induced Murine Sarcomas," *Int. Jour. Cancer* **6** (1970): pp. 245–249.

[18] I. Hellström and K. E. Hellström, "Cytotoxic Effect of Lymphocytes from Pregnant Mice on Cultivated Tumor Cells. I. Specificity, Nature of Effector Cells and Blocking by Serum," *Int. Jour. Cancer* **15** (1975): pp. 1–16.

[19] I. Hellström and K. E. Hellström, "Cytotoxic Effect of Lymphocytes from Pregnant Mice on Cultivated Tumor Cells. II. Blocking and Unblocking of Cytotoxicity," *Int. Jour. Cancer* **15** (1975): pp. 30–38.

Sera from multiparous mice were found to be capable of blocking the cytotoxic response of lymphocytes from multiparous animals.[18, 19] The blocking factors appear to be, at least to a large extent, complexes between IgG_2 immunoglobulins and embryonic antigens (J. Tamerius *et al.*, to be published). To what extent free circulating embryonic antigens also act as blocking factors is so far unknown. Blocking activity of serum from multiparous mice could be removed by absorption with either tumor cells or normal embryonic cells. The tumor cells, as well as the normal embryonic cells, could be obtained directly from the animals, suggesting that at least some of the embryonic antigens are expressed on at least some of the tumor (or embryonic) cells growing *in vivo*.

An interesting finding was that serum from tumor-bearing animals could also block the cytotoxic response of lymphocytes from multiparous mice and that this blocking activity was higher when the serum was derived from an animal carrying the tumor used as a target in the given test. Likewise, the ability of cells of the respective tumor line to remove blocking serum activity by absorption was higher than when cells from other tumor lines were used. This suggests that, in addition to whatever individually unique tumor-specific transplantation antigen a neoplastic cell may have, there is a certain level of specificity also as far as the embryonic antigens are concerned and that there may be a family of embryonic antigens rather than a single one.

Our next step was to approach the question whether the common failure to detect transplantation immunity to embryonic tumor antigens may be due to the fact that these antigens strongly block the immune response (in the form of free antigen or as antigen-antibody complexes). In order to study this, we used animals which had been immunized against tumor-specific transplantation antigens in a classical way, i.e., by inoculation of tumor cells followed by surgical removal of the tumors formed, as well as animals immunized with embryonic cells. The data showed that mice which had tumor-specific transplantation resistance, but no detectable *in vivo* reactivity to common embryonic tumor antigens, had blocking serum factors which could cancel the cytotoxic effect of lymphocytes from multiparous mice.[19] On the other hand, no blocking activity was detected when sera from these mice were tested together with lymphocytes from mice immune to the specific transplantation antigens of the respective tumors.

These findings are compatible with the hypothesis that the failure of embryonic tumor antigens to induce transplantation resistance *in vivo* is due to their ability (either alone or in the form of antigen-antibody complexes) to prevent immune lymphocytes from attacking tumor cells.

Experiments were then performed to test whether unblocking antibodies could be produced by immunizing rabbits with embryonic mouse cells, followed by extensive absorption of the sera *in vitro* and *in vivo* with normal adult mouse cells.[19] Unblocking antisera could, indeed, be produced. The unblocking activity was found to reside in the immunoglobulin fraction of the serum.

Hypothesizing that the blocking activity of embryonic antigens may prevent them from provoking a transplantation resistance *in vivo*, we then immunized mice with normal embryonic cells, or with either of two different sarcomas, inoculated them with unblocking (or control) sera, and transplanted them with tumor cells. Mice immunized with embryonic cells and given unblocking antisera were less apt to accept transplanted tumor cells than were the various control mice used.[20] If these data are confirmed by further work, they add some weight to the suggestion that the ability of embryonic tumor antigens to block lymphocyte-mediated cytotoxic responses explains why they do not act as transplantation antigens *in vivo*. Further work in this area might provide opportunities for both a preventive and therapeutic approach to tumors possessing embryonic antigens. However, since very little is known about the extent to which any of these embryonic antigens are present in normal cells, e.g., during certain phases of the cell cycle, there may be a clear risk that any immunization to such antigen which is capable of preventing tumor growth may damage the immunized individual.

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[20] K. E. Hellström and I. Hellström, "The Role of Blocking Serum Factors in Immunity to Embryonic Tumor Antigens," in: *Critical Factors in Cancer Immunology* (The Seventh Annual Miami Winter Symposia), J. Schultz and R. C. Leif, eds. (New York, Academic Press, 1975) **10**: pp. 221–229.

SUMMARY

Immune responses can be detected against a variety of neoplasms in animals and man. Those detected in man are generally directed against antigens common to tumors of the same histological type.

Many different ways exist by which tumor cells may escape from damage by the immune response. An important such mechanism involves the ability of tumor antigens, alone and in the form of complexes with antibodies, to block (inhibit) the cytotoxic response, as studied *in vitro*.

Many tumors share antigens with normal embryonic cells. Recent data suggest that the blocking mechanism may prevent such embryonic tumor antigens from functioning as tumor-specific transplantation antigens *in vivo*; whether this is the reason why the embryonic antigens do not act as transplantation antigens needs further study.

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TREATMENT STRATEGY FOR THE CURE OF CANCER

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(Read November 15, 1974, in the Symposium on New Approaches in the Study of Neoplasia)

ABOUT ONE-THIRD of patients who develop cancer are cured by treatment. While most of these cures are the result of surgical removal of the tumor, some are brought about by radiation, and in recent years a few kinds of cancer have been cured by drugs. It is my purpose today to review cure by drug treatment, and to show how these successes have led to a strategy for the control of cancer.

Cancer starts as a highly localized disease, probably from the transformation of one normal cell into a cancer cell. In most instances this cell remains at its place of origin, dividing into daughter cells. Over a period of months or years there are some forty divisions or generations, resulting in a tumor that can be felt by the patient or detected by the physician. There are many benign tumors that will forever remain at the local site and are easily removed by the surgeon. A tumor is called a cancer when it can spread, at first by invasion of surrounding areas, and later by small groups of cells detaching themselves from the parent mass and traveling to distant parts of the body where they take root and grow as independent cancers. This process of distant spread is called metastasis, from the Greek word meaning removal from one place to another, and the new, independent tumors are called metastatic cancer or simply metastases. In most instances the first spread beyond the locally invaded area is to the lymph nodes that are closest to the primary tumor. The lymph circulation is a drainage system whose function is to return fluid that has seeped into the tissues back into the blood stream. At various points in this drainage system, the lymph percolates through lymph nodes, which can filter out foreign materials such as bacteria or cancer cells. For this reason, often the first evidence of spread is enlargement of the nodes draining the area where the primary tumor resides. For a while, the cancer is confined to the primary site and its adjacent nodes, but sooner or later small groups of cells again escape and lodge in almost any distant organ.

When the cancer is localized and has not spread beyond its site of origin, it can almost always be cured by the surgeon, if it is technically feasible to remove the tumor. Brain tumors in certain vital areas are examples of cancers that cannot be removed. Sometimes it is possible to cure a cancer even after it has involved the lymph nodes, provided it has not spread beyond the nodes. Thus surgery cures many cancers, but its success is limited to truly localized disease. X-irradiation is another form of localized treatment, but it is not usually employed if surgery is feasible. Sometimes surgery and radiation are used together to reinforce each other in getting rid of the malignant cells in the localized sites. But the main use of radiation is for the relief of symptoms arising from metastases.

Localized forms of treatment cannot cure when cancer is widespread, either because it has gone beyond the original site, or because it was disseminated right from the start, as in acute leukemia. When the tumor has spread, a form of treatment is required that is effective against tumor cells anywhere in the body. The only treatment capable of doing this at present is chemotherapy, the use of drugs. While it was known for about eighty years that arsenic favorably influenced leukemia, chemotherapy had its beginnings in 1941. In the intervening thirty-three years a number of anti-cancer drugs have been discovered, at first with painful slowness, but in the last few years with ever-increasing speed. There are now at least forty-five drugs that can kill tumor cells and that can be given in a way that will not cause life-threatening toxicity in the patient. In the early 1960's proof was adduced of cure of two types of cancer after they had become widespread. In the past ten years cure has been shown for eleven different types of metastatic cancers.[1]

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[1] C. G. Zubrod, "Present Status of Chemotherapy," *Life Sciences* **14** (1974): pp. 809–819.

Cure is a word of so many meanings that it requires definition. In the sense used here, it means that a group of patients with a particular kind of cancer, after treatment, has a normal life expectancy as compared to the life expectancy of the whole population. In other words, cure is achieved for the surviving group of patients when they can be shown to live just as long as the average. There are actuarial techniques for making such comparisons [2] and these have shown that normal life expectancy, by virtue of the use of chemotherapy, has been achieved for the eleven kinds of cancer shown in table 1. Drug treatment is not successful in all instances, the cure rate ranging from 90 per cent to 10 per cent. These tumors are uncommon types of cancer, and in the aggregate constitute only about ten per cent of clinical cancer.

TABLE 1

NORMAL LIFE EXPECTANCY IN METASTATIC CANCER AS A RESULT OF CHEMOTHERAPY, EITHER ALONE OR WITH SURGERY AND X-IRRADIATION

Metastatic disease	Percentage with normal life expectancy
Choriocarcinoma	75
Burkitt's lymphoma	60
Retinoblastoma	60
Wilms' tumor	50
Acute lymphocytic leukemia	50
Rhabdomyosarcoma	50
Hodgkin's disease (advanced)	50
Ewing's sarcoma	50
Diffuse histiocytic lymphoma	40
Mycosis fungoides	25
Embryonal testicular cancer	15

Why are the uncommon cancers curable by chemotherapy? The understanding of drug susceptibility started with the observation that all of the sensitive cancers were rapidly growing tumors, while most of the non-susceptible tumors grew slowly. This of course just converts the question into "why do tumors grow rapidly?" The answer is that rate of growth depends upon the percentage of cells that are dividing per unit of time.[3] A tumor with 100 per cent of its cells dividing will grow tenfold faster than one with 10 per cent of its cells dividing. Now it is important to recognize that if the drug is present at or in the cell during cell division one or another of our forty-five available drugs will kill the cells during some part of the division process. Therefore, the tumor with 100 per cent of its cells dividing is quickly got rid of, while the tumor with 10 per cent dividing cannot be cured by drugs.

As any living organism grows older, its rate of growth slows. This plateau of growth is just as true for tumors as it is of a baby. A baby doubles its weight in the first six months. If rate of growth did not slow down, by age ten the child would weight over seven million pounds. The reason for slowing of growth is again the percentage of cells that are dividing at any one time. Therefore tumors that are discovered when young may be curable by drugs; those discovered when the malignant tissue is old are not curable by drugs. The continuing high mortality from cancer is due to the fact that most cancers are discovered only when they are old. When a tumor has been in the body for a long time, it is likely that it has metastasized and the metastases cannot be reached by surgery or radiation, while the primary tumor cannot be cured by drugs because it is biologically old. But what of the age of the metastases, as compared to the older original tumor? One would guess that at some point the metastases, having wandered away from the original tumor late in its growth history, would be young and drug-sensitive. This turns out to be exactly the situation.[4] Now we already have an effective way of getting rid of old tumors, namely, by surgery or irradiation. As I pointed out in the beginning, the failures of surgery occur because, at a time when the tumor seems localized and removable, there are often metastases that are so small that the physician cannot detect their presence. The patient may seem well for years after surgery, but these occult metastases continue to grow and result in the death of the patient. But with the new ability to cure metastatic disease with drugs, the possibility of reducing cancer deaths by using surgery for the old tumor and drugs for the young tumor becomes realistic. Indeed in certain childhood tumors the effectiveness of surgery plus chemotherapy has already been demonstrated. It is only recently that studies combining surgery and drugs have been started in adult patients with cancer.

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[2] J. Berkenson and R. P. Gage, "Calculation of Survival Rates for Cancer," *Proc. Staff Meetings. Mayo Clinic* **25** (1950): pp. 270–286.

[3] H. E. Skipper, "Cancer Chemotherapy Is Many Things" (G. H. A. Clowes Memorial Lecture), *Cancer Research* **31** (1971): pp. 1173–1180.

[4] L. Simpson-Harren, A. H. Sandford and J. P. Holmquist, "Cell Population Kinetics of Transplanted and Metastatic Lewis Lung Carcinoma," *Cell Tissue Kinetics* **7**: pp. 349–361.

The preliminary results in breast cancer are quite encouraging because the drugs given after radical mastectomy are apparently preventing the relapses that would have been expected.[5]

Does this mean that we have all the theoretical information needed to prevent all deaths from cancer? I seriously doubt that this is so, but the answer is really indeterminate at this time. There probably exists enough of a theoretical base to reduce the mortality of breast cancer, but it will take many years to be able to judge the impact of this knowledge on reduction in mortality, simply because of the relatively slow pace of its natural history. And then there are all the other old tumors such as lung cancer and pancreas cancer about which much less is known, but in any event an approach has been discovered that I am confident will reduce the present mortality in at least some of the patients with slow-growing, old cancers.

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[5] R. Nissen-Meier, E. R. Jellgren and B. Mason, "Preliminary Report from the Scandinavian Adjuvant Chemotherapy Study Group," *Cancer Chemotherapy Reports* **55** (1971): pp. 561-571.

THE SIGNIFICANCE OF CACAO PRODUCTION IN THE AMAZON REGION DURING THE LATE COLONIAL PERIOD: AN ESSAY IN COMPARATIVE ECONOMIC HISTORY[1]

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AMONG THE HUNDRED or more cultigens that Europeans found upon their arrival in the New World, the most important beverage source was the cacao tree. Cultivated by the Amerindians of Central America a millennium or more before Columbus, the cacao or cocoa tree was the primary source of a drink, chocolate, that competed favorably with coffee and tea in the luxury markets of Europe during the seventeenth and eighteenth centuries. Consequently, cacao became one of the major staples that, with varying degrees of success, each imperial power tried to produce in tropical America.[2] But despite the extensive primary and secondary literature concerning the development of the cacao industry,[3] Erneholm's statement that ". . . our knowledge of the economic geography of cacao is so imperfect [that] . . . practically no detailed studies of the various production areas are available . . ." remains largely as true today as it did a quarter century ago.[4] The objectives of the present essay are first to examine the origins and expansion of cacao cultivation in the New World; second, to suggest reasons for the growth of European interest in the beverage; third, to analyze the development of cacao production in one generally overlooked region—the Portuguese Amazon—during the eighteenth and early nineteenth centuries; and finally to evaluate the significance of Amazonian cacao upon the regional economy and upon the European markets.

Botanists now recognize twenty-two species of the genus *Theobroma cacao,* but only two, *Cacao criollo* and *C. forastero,* are of commercial importance.[5] Experts continue to dispute the original hearth or hearths where cacao was first domesticated. The most likely candidates are the Upper Amazon basin and some part of Central America.[6] Certainly a tropical origin is indicated, for while the cacao tree can tolerate variations in rainfall from 45 to 200 inches per year and will grow in elevations from sea level to nearly 4,500 feet, it requires mean annual temperatures of *ca.* 70° F and is intolerant of persisting temperatures below 60° F. Where there exists sufficient drainage, high humidity, adequate protective sun and wind shelter, and favorable rainfall and temperature regimes, cacao flourishes between 20° N. and S. Lat.[7]

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[1] This essay is a byproduct of a long-term study concerning the economic role of the Jesuits in the Portuguese empire. The initial phase of archival work for the larger study was undertaken in Portugal during 1968–1969 and was partly supported by grants from the American Philosophical Society, the Council for Research in Economic History, the Calouste Gulbenkian Foundation, and the Graduate School of the University of Washington, for each of which I remain sincerely grateful. Archives consulted for the present study were: the Arquivo Histórico Ultramarino (AHU), primarily miscellaneous documents (*Papeis Avulsos* [PA]) kept in boxes (*caixas* [cxs.]) and a number of codices (cod.[s]); the Biblioteca Nacional (BNL), both its Fundo Geral (FG) and its Coleção Pombalina (CP) series; the Instituto Nacional de Estatística (INE); the Arquivo do Ministério das Obras Públicas (AMOP); and the Biblioteca Pública de Évora (BPE).

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[2] On the etymology of the words cacao and chocolate see J. Eric S. Thompson, "Notes on the Use of Cacao in Middle America," *Notes on Middle American Archeology and Ethnology,* No. 128 (1956; rpr., New York, 1969), **5**: pp. 107–109, and Rúbio Sánchez (cited in n. 23 below).

[3] The two bibliographies that I found most helpful are Wolf Mueller, *Bibliographie des Kakao. Seiner Geschichte, Kultur, Verwendung, Verarbeitung, wirtschaftlichen Bedeutung* (Hamburg, 1961) which lists some 5,000 entries for articles and books in all relevant languages, and a 3 by 5 inch card file accumulated during the course of nearly three decades hy the late Roland Denis Hussey in preparation for a never-written history of cacao. The box, which contains *ca.* 800 meticulously annotated cards as well as some research notes, is now in the custody of Professor Robert N. Burr, Department of History, University of California, Los Angeles.

[4] Ivar Erneholm, *Cacao Production in South America. Historical Development and Present Geographical Distribution* (Göteborg, Meddlelands från Göteborge Högskolas Geografiska Institution) **34** (1948): p. 11. Together with Wolf Mueller, *Seltsame Frucht Kakao. Geschichte des Kakaos und der Schokolade* (Hamburg, 1957), this is one of the most recent general studies. The outstanding regional economic study of cacao remains that of Arcila Farias (cited in n. 37 below).

[5] José Cuatrecasas, "Cacao and its Allies. A Taxonomic Revision of the Genus Theobromba," U. S. National Museum, *Contributions from U. S. National Herbarium* **35,** 6 (1964): pp. 379–614.

During the colonial era the spectacular appearance of cacao vividly impressed newcomers to the tropics, frequently reminding them of the orange, cherry, or plum trees they had known at home. Standing from 25 to 40 feet in height and encompassed by an oaklike densely branching canopy, the cacao tree in season is covered with brightly colored saffron yellow and purple blossoms which form on all parts of the tree, including the trunk as well as the branches and especially in the interstices between the former and the latter. These flowers produce pendulous clusters of elongated fruit superficially resembling cucumbers. A single tree may produce between twelve and eighteen such fruit, some weighing up to a pound or more. As the pods ripen, their color gradually changes from dark green to bluish-red or yellow, depending on specie. Within their thick rind and spongy white pulp and separated by a tough center stalk are double rows of twenty to fifty almondlike beans which, when dried and pulverized, form the basis of the beverage the Aztec and other Nahuatl-speaking peoples called *chocolatl.*[8]

The first known European observation of cacao occurred in 1502 during the fourth voyage of Columbus when the admiral was off the north coast of Honduras, where he intercepted an Indian canoe whose cargo included a quantity of cacao beans which the aborigines obviously prized.[9] By this time the limits of aboriginally grown cacao extended along both the Caribbean and especially the Pacific lowlands of Central America from modern Costa Rica as far north as the Mexican states of Colima and Veracruz. Throughout Meso-America it served as a ceremonial and a luxury beverage and its beans were media of exchange. Before Cortés reached Mexico, cacao had become a major article in the land and sea trade between the Mayan lands and those of the Aztecs, and constituted an important item of tribute that the highland Aztecs exacted from subject peoples in the wet, warm lowlands bordering on either side of the isthmus of Tehuantepec.[10]

The Spaniards did not become interested in cacao until they conquered Mexico. During the occupation of Tenochtitlán they encountered large quantities of cacao stored in the royal warehouse of Moctezuma II. According to the chronicler Bernal Díaz, "In the tribute books of Moctezuma we saw whence they brought him tribute of gold and where there were mines and cacao . . . and we wished to go to those places whence . . . they brought these things. . . ." [11] Under Spanish prodding cacao production quickly expanded, temporarily in southern Mexico and for a much longer period in the neighboring captaincy-general of Guatemala. Such expansion in part reflected the Spaniards' take-over of existing orchards, but it was also a consequence of the tribute levies they imposed upon highland Indians who were forced to seek work in cacao districts to discharge their burden. In addition, Indian growers were encouraged to intensify the planting of what had previously been for them a secondary crop.[12]

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[6] *Ibid.,* pp. 409–413.

[7] *Ibid.,* p. 430, and John F. Bergmann, "Cacao and its Production in Central America," *Tijdschrift von Economische en Sociale Geografie* (Feb., 1957), pp. 43–48, at 43–44.

[8] The classic description is that of the sixteenth-century chronicler, Gonzalo Fernández de Oviedo y Valdés, *Historia general y natural de las Indias* . . . , Lib. 8, Chap. 30 (Asunción, Editorial Guarania, 1944) **2**: pp. 245 f. See also William Dampier, *A New Voyage Round the World* (1st ed., London, 1697; rpr., London, 1937), pp. 50–52, and Bryan Edwards, *The History . . . of the British West Indies* (5th ed., London, 1819) **2**: pp. 363–364n. Numerous other descriptions are included in the following citations.

[9] *The Life of the Admiral Christopher Columbus by his Son Ferdinand,* tr. and ed. Benjamin Keen (New Brunswick, 1959), p. 232.

[10] The outstanding study of aboriginally grown cacao is John F. Bergmann, "The Distribution of Cacao Cultivation in Pre-Columbian America," *Annals of the Association of American Geographers* **59** (Mar., 1959): pp. 85–96. See also René Francis Millon, "When Money Grew on Trees: A Study of Cacao in Ancient America" (unpublished Ph.D. diss., Columbia University, 1955), and David Browning, *El Salvador* [:] *Landscape and Society* (Oxford, 1971), pp. 12–14.

[11] Bernal Díaz del Castillo *The True History of the Conquest of New Spain,* tr. A. P. Maudslay Hakluyt Society, *Works,* ser. 2, No. 30 (London, 1912): p. 202.

By the 1540's the yield of most of the Mexican sources was in decline because of rapid native depopulation. However, because of growing demand, prices advanced sharply and Mexican distributors turned to sources of supply in Guatemala, especially to Sonsonate (modern El Salvador).[13] According to mid-century accounts, those districts were assessed aggregate tribute quotas in excess of 300,000 pounds, an amount that the geographer Bergmann estimates approximated 5 per cent of their annual crop.[14] By 1560 the captaincy-general of Guatemala annually exported to Mexico more than 1,000,000 pounds of cacao, a figure destined to increase by two and a half times by 1576.[15] Part of these shipments went overland by muleback and by human bearers, but those from Sonsonate traveled by sea as far as the Pacific port of Huatulco, predecessor of Acapulco.[16] When Cavendish sacked that port in 1587, he destroyed more than 100,000 *cargas* (= 50-pound loads) of cacao.[17]

Although surviving statistics are inadequate for precise measurement, it is evident that the demand for cacao in Mexico continued to grow steadily. Despite the establishment of a royal mint in Mexico City (1539), cacao beans continued to be used throughout the sixteenth century in market transactions as substitutes for fractional copper coins; in outlying parts of the vice-royalty of Mexico they served as wage payments until late in the century.[18] But undoubtedly they were chiefly utilized in beverage form. The extent to which non-noble Indians in the Mexican highlands partook of chocolatl in pre-Cortesian times is unclear, but it is apparent that its consumption became widespread among Indians of all classes in post-conquest decades.[19] Along with bread, cacao became part of the standard ration on the Cortés estates and probably on other rural properties as well.[20] In the course of time the more urbanized Spaniards also gradually acquired the chocolate habit. Presumably this came about after modification of the standard Indian method of preparation—powdered cacao steeped in hot water or boiled with honey, cornmeal, and peppers—which some commentators found unappealing.[21] By the turn of the seventeenth century chocolate, formerly a luxury item in Mexico and destined to remain one in most other parts of the world until the nineteenth century, had become a prime necessity, as it continued to be throughout the colonial period.[22]

From about 1550 until the second half of the seventeenth century the chief supplier of the Mexican market was the captaincy-general of Guatemala. Guatemalan cacao came principally from a relatively narrow zone of lowlands and piedmont on the Pacific coast extending from

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[12] In addition to the sources cited in note 10, this analysis is based upon John F. Bergmann, "Cacao in Early New Spain," in an unpublished paper of *ca.* 1958.

[13] Charles Gibson, *The Aztecs under Spanish Rule. A History of the Indians of the Valley of Mexico, 1519–1810* (Stanford, 1964), pp. 348–349, and Woodrow W. Borah and Sherburne F. Cooke, "Price Trends of Some Basic Commodities in Central Mexico, 1531–1570," *Ibero-Americana* **#40** (Berkeley, 1958): pp. 36–37, 77.

[14] Bergmann, "Distribution," pp. 89–94.

[15] Same, "Cacao in Early New Spain," p. 4, where the calculation is based upon 50-pound loads (*cargas*).

[16] Woodrow W. Borah, "Early Colonial Trade and Navigation between Mexico and Peru," *Ibero-Americana* **#38** (Berkeley, 1954): pp. 24, 65, and 71.

[17] José Acosta, *Historia natural y moral de las Indias* . . . (1st ed., Sevilla, 1590), ed. P. Francisco Mateos (Madrid, Biblioteca de Autores Españoles, 1954), Lib. IV, Chap. XXII, pp. 116–117, and "The admirable and prosperous voyage of . . . Master Thomas Ca[ve]ndish . . . into the South sea, and from thence round about the circumference of the whole earth, begun in 1586, and finished 1588 . . . by Francis Pretty," in Richard Hakluyt, *The Principal Navigations Voyages & Traffiques & Discoveries of the English Nation* (London, Everyman ed., [1907]) **8**: pp. 231–232.

[18] Borah, "Price Trends," p. 36.

[19] Erneholm, *Cacao Production,* pp. 30–31; Gibson, *Aztecs,* pp. 348–349; and Bergmann, "Cacao in Early New Spain," p. 3.

[20] Borah, "Price Trends," p. 24, n. 27, and Ward J. Barrett, *The Sugar Hacienda of the Marqueses del Valle* (Minneapolis, 1970), p. 96.

[21] E.g., the Italian soldier of fortune Girolamo Benzoni, who visited the Caribbean in the 1540's and 1550's, wrote that he considered chocolate "more suited for pigs than for men," that "I was upwards of a year in that country [Nicaragua] without ever being induced to taste this beverage . . . But . . . wine failing, and unwilling to drink nothing but water, I did as others did. The flavour is somewhat bitter, but it satisfies and refreshes the body without intoxicating; . . ." *History of the New World,* tr. and ed. W. H. Smyth, Hakluyt Society, *Works,* ser. 1, No. 21 (London, 1957): pp. 149–150. More than a century later Sir Hans Sloane admitted that ". . . it was more than a year before I could drink of it, for which the Indians would laugh at me: . . ." *Natural History of Jamaica, and Voyage to the Islands of Barbadoes, Madeira, Nieves and St. Christopher's* (2 v., London, 1707, 1727) **2**: p. 17.

[22] Gibson, *Aztecs,* p. 349. On the penchant of North Mexican miners for hot chocolate, see the fascinating article by Peter Boyd-Bowman, "Two Country Stores in XVIIth Century Mexico," *The Americas* **28** (Jan. 1972): p. 249 n. 23.

Soconusco in the northwest to the rich volcanic soils of Izalco or Sonsonate in the Southeast. Although there were cacao-producing districts on the Caribbean coast of Guatemala and Honduras and in the southern parts of Central America, such as the lake country of Nicaragua and the province of Nicoya in Costa Rica, they were far less important than the Pacific lowlands. At the beginning of the seventeenth century cacao was the captaincy-general's leading export crop with an estimated annual yield of somewhere between 6 and 9 million pounds. By the end of the century, however, exports had fallen to 1.5 million; a century later they stood at a mere 300,000. Various factors have been adduced to account for the collapse of the Guatemalan cacao industry; among them, Indian preference for crops that matured more rapidly, thus facilitating their tribute payments; catastrophic decline of Indian labor as a result of disease and excessive exploitation; destructive volcanic eruptions; religious phobias against cultivation of the crop; and competition by cheaper, inferior cacaos.[23] Such competition came from two parts of the Spanish empire where cacao had not been cultivated in pre-Columbian times,[24] namely Quito (Ecuador) and northern South America, especially Venezuela.

The origins of plantation-grown cacao in Ecuador remained to be discovered. The Szásdis infer that Guayaquileño cacao was being shipped to the isthmus of Panama as early as 1569, but neither Lopez de Velasco nor José de Acosta substantiates that contention.[25] It is clear, however, that by 1617, when the Carmelite Vázquez de Espinosa visited the presidency of Quito, there were already many cacao plantations along both banks of the Guayas River.[26] Two decades later, in 1635, the High Court (*audiencia*) of Guatemala responded to an appeal by cacao growers in that captaincy-general by barring the entry of *cacao del Perú*, meaning Quiteño cacao, in ports under its jurisdiction.[27] That tribunal's action was consistent with the then newly announced royal policy prohibiting all trade between Spain's northern and southern vice-royalties.[28] The Szásdis appear to be on solid ground when they argue that the repeated renewals of that prohibition demonstrate the persistence of contraband trade between Quito and the Pacific ports of Guatemala and Mexico.[29] Although consumption of cacao within the presidency of Quito remained negligible throughout the colonial era,[30] and Peru served as the only legal exterior market,[31] the Ecuadorian cacao industry continued to expand throughout the seventeenth century until the margins of the Guayas and the adjacent lowlands were dominated by cacao orchards for a distance of fifty miles above the Guayaquil entrepôt.[32]

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[23] No adequate history of the cacao industry in the captaincy-general of Guatemala exists. In addition to Thompson (cited n. 2 above) and Bergmann (cited n. 10 above), the foregoing is based chiefly on Manuel Rubio Sanchez, "El Cacao," *Anales de la Sociedad de Geografia e História de Guatemala* **31** (1958): pp. 81–106: Felix Webster McBryde, "Cultural and Historical Geography of Southwest Guatemala," Smithsonian Institution. Institute of Social Anthropology, *Publication* #4 (Washington, D. C., 1945): pp. 11, 33–34; and Browning, *El Salvador*, pp. 38, 52–64. See also Pierre and Huguette Chaunu, *Seville et l'Atlantique (1504–1650)* **8, 1** (Paris, S.E.V.P.E.N., 1959): pp. 855–858. The recent research in Guatemalan archives by Professors John Henry Ibarguen (Weber State University) and Herbert S. Klein (Columbia University) promise to deepen our knowledge of the cacao trade between Guatemala and Mexico. Much new light concerning the rise and decline of cacao production in Central America is shed in Murdo J. MacLeod, *Spanish Central America: A Socioeconomic History, 1520–1720* (Berkeley, 1973).

[24] For a discussion of this mooted point see Bergmann, "Distribution," pp. 87–88, and p. 4 of the Szásdi article cited in n. 25.

[25] Dora León Borja [Szásdi] and Adám Szásdi Nagy, "El Comercio del cacao de Guayaquil," *Revista de historia de América* **57–58** (Jan.–Dec., 1964): pp. 1–50. Based mainly on printed sources, this is a useful, albeit pro-Quiteño study. *Cf.* Acosta (cited n. 17) and Juan López de Velasco, *Geografia y descripción universal de las Indias . . . desde . . . 1571 al . . . 1574* (Madrid, 1894), pp. 17, 430–446.

[26] Antonio Vázquez de Espinosa, *Compendium and description of the West Indies*, tr. Charles Upson Clark, Smithsonian Institution, Miscellaneous Collections **102** (Washington, D. C., 1942): p. 371. The padre observed that "These cacao trees are not cultivated with the same devoted pains as in New Spain and Honduras: [but] the planting of them has enriched many people and swollen their tithes and revenues." On Quito's so-called cacao boom of the early seventeenth century, see also John L. Phelan, *The Kingdom of Quito in the Seventeenth Century . . .* (Madison, 1967), p. 17.

[27] José Milla, *Historia de la América Central, desde . . . 1502 hasta . . . 1821* (Guatemala, 1879) **2**: p. 275.

[28] Borah, "Trade and Navigation" (cited n. 16), chap. VII. The general intent of the crown was to protect the commercial interests of Peninsular merchants who traded with the empire, but, as will be shown below, it also deliberately encouraged the cacao trade of Venezuela with New Spain while prohibiting that of Quito. For an astute analysis of the Habsburgs' system of intra-imperial preferences, see John Lynch. *Spain under the Habsburgs* (2 v., New York, 1964–1969) **2**: pp. 227–228.

[29] Borja and Szásdi, p. 10; see also, Dampier (cited n. 8), p. 110, and Jorge Juan and Antonio de Ulloa, *A Voyage to South America . . . ,* (2d ed., 2 v., London, 1760) **1**: pp. 104, 199. The bitter rivalry between Caraqueño and Quiteño cacao interests for the coveted Mexican market was of long duration. For the years 1693–1778 it may be partially traced through a series of protests to the crown by the Caracas *cabildo* (municipal council) against the illicit trade by its rival. See Enrique Bernardo Nuñez, comp., *Cacao*, introd. by

Production estimates for Quiteño cacao prior to 1700 are lacking. For the first quarter of the eighteenth century the annual harvests averaged 2.7 million pounds. During the second quarter they ranged between 3.2 and 4.0 million, a level evidently also maintained during the next twenty-five years. However, between 1772 and 1802 they rose from 3.2 to 8.1 million, and during the first quarter of the nineteenth century they nearly doubled again, reaching between 14.5 and 15.4 million during the years 1821–1825. By the end of the colonial period cacao accounted for between two-thirds and three-quarters of Guayaquil's exports and constituted the principal source of the wealth of the presidency's leading citizens.[33]

The onset of Quito's first cacao boom, beginning in the 1770's and lasting until the 1840's,[34] was a direct result of the Bourbon monarchs' gradual relaxation of intra-imperial commercial restrictions between the 1760's and the 1780's. At first the crown permitted only limited quantities of Quiteño cacao to enter Acapulco, but such quotas did not deter smugglers and in 1788 free trade between Guayaquil and Acapulco was officially authorized.[35] By the turn of the nineteenth century the cheaper, inferior Quiteño cacao had captured 75 per cent of the Mexican market, one that had long belonged to Venezuelan interests.[36]

The beginnings of cultivated cacao in Venezuela are likewise obscure.[37] The first reference to cacao in this area dates from the 1570's, but it does not indicate that deliberate planting had yet begun.[38] A generation later, however, the Carmelite Vázquez de Espinosa reported that cacao was being grown in the "fertile valleys and meadows for a distance of over 40 leagues" around Caracas and that since 1615 there had existed

> large cacao orchards and plantations, which bear harvests . . . in great abundance. They brought down these cacao trees from the sierras and ridges of the inland country, where there were great thickets and woods of wild cacao . . . ; they made up great bundles of these wild trees, transported them and created plantations . . . ; these trees are not so delicate to raise as those in New Spain and Honduras.[39]

In the course of the seventeenth century the planting of cacao spread throughout the central valleys situated between the seacoast and the Andean salient from the Maracaibo basin in the west as far eastward as the island of Trinidad.

The Venezuelan product first entered the Mexican market in the 1620's. From some point

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Orlando Araujo (Caracas, 1972), especially pp. 107, 110–119, 123–125, 131–133, 209–215, 226, and 254–256.

[30] As Juan and Ulloa observe (*ibid.* **1**: p. 199), "It is something singular, that in this city [Guayaquil] and jurisdiction, where cacao grows in such plenty, little or no use should be made of it."

[31] Juan and Ulloa, *loc. cit.;* see also, Woodes Rogers, *A Cruising Voyage Round the World* (1st ed., 1712; rpr., New York, 1970), p. 145.

[32] Michael T. Hamerly, "A Social and Economic History of the City and District of Guayaquil during the late Colonial and Independence Periods" (unpublished Ph.D. diss., University of Florida, 1970), pp. 129, 131, and 138.

[33] *Ibid.,* tables 24 and 25, pp. 141, 145–146, where the totals are given in terms of the Guayaquileño *carga,* a load equal to 81 lbs. Hamerly found that the ratio of harvests to exports was about 3:1 and that one-third of the harvest was usually unmarketable because of spoilage and inferior quality. For further confirmation of such losses, see Henry Wood to George Canning, Feb. 28, 1826, in R. A. Humphreys, ed., *British Consular Reports on the Trade and Politics of Latin America 1824–1826,* Camden 3d ser., **63** (London, Royal Historical Society, 1940): pp. 229–230.

[34] A second boom began two decades later. Hamerly, p. 146.

[35] *Ibid.,* pp. 147–148.

[36] Borja and Szásdi, pp. 40–41 and sources cited there. The Szásdis calculated that the voyage between Guayaquil and Acapulco averaged 7 to 9 weeks, compared with a thirty-day run between La Guaira (the port of Caracas) and Veracruz. Offsetting the shorter haul, however, were the higher prices of the more appreciated Venezuelan product and its heavier transportation charges from plantation to dockside. *Ibid.,* pp. 45–49. For a comparative evaluation of the quality of Quiteño, Caraqueño, and Guatemalan cacaos, see William B. Stevenson, *A Historical and Descriptive Narrative of Twenty Years' Residence in South America* (3 v., London, 1825) **2**: pp. 231–232.

[37] The origins of cacao cultivation in Venezuela is one question that Eduardo Arcila Farias did not examine in his otherwise model study *El Commercio entre Venezuela y México en los siglos xvii y xviii* (Mexico, 1950) which supplements and in part supersedes Roland Denis Hussey, *The Caracas Company, 1728–1784 . . .* (Cambridge, Mass., 1934).

[38] Lopez de Velasco, p. 371.

[39] Vázquez de Espinosa, pp. 96–97.

during the second half of that century until the 1770's it dominated that market. But the volume of Venezuelan exports to New Spain remained surprisingly low during the seventeenth century, averaging slightly over half a million pounds a year.[40] Such a figure is not a reliable indicator of total production, however, partly because there developed a significant internal market for the local product,[41] and also because Dutch smugglers based on the island of Curaçao carried allegedly large (but unrecorded) quantities of Venezuelan cacao to European markets from the 1630's until well into the eighteenth century.[42] The costs of such illicit trade increased following the establishment of the royal monopoly trading company known as the Caracas Company (1728–1785).

During the eighteenth century Venezuelan cacaos came to be esteemed as superior in quality to all others grown in the New World.[43] Registered annual exports climbed from 1.4 million pounds in the 1690's to 2.6 in the 1720's, reaching over 5 million in the 1730's; after dipping to 4.6 million during the wartime decade of the 1740's, they rebounded in the 1750's and 1760's to 6.3 million, a level that appears to have been maintained throughout the 1770's.[44] During the last quarter of the century cacao represented from two-thirds to three-quarters by value of the total exports of La Guaira, Venezuela's principal port,[45] a degree of importance comparable to that prevailing in the rival port of Guayaquil.

In the course of the eighteenth century the pattern of Venezuela's cacao exports shifted radically. While they continued to dominate Mexican markets until the 1770's, thereafter, as already observed, they were largely replaced by the inferior but cheaper Guayaquileño product.[46] But the loss of primacy in that colonial market was more than offset by the increasing volume of Venezuelan cacao exports to Spain. Not until the decade of the 1730's did they exceed those sent to Mexico, but they did so, often by margins of two or three to one, during most of the remainder of the century. And the ever larger volume of Venezuelan cacao shipped to the Iberian Peninsula was not only an index of the Spanish government's successful campaign against Dutch smugglers; it was also a response to the growing popularity of chocolate in Europe.[47]

As was the case with tobacco, keen European interest in chocolate did not begin until the early seventeenth century. The first recorded imports of cacao by Spain appear to date from the first decade of that century.[48] Traditionally the Florentine globetrotter Francisco Carletti is credited with having introduced chocolate to Tuscany about 1606.[49] It was in use in certain monasteries in Austria by the 1620's, when a celebrated Franciscan critic attacked its consumption on the ground that it was an inflamer of passions.[50] By 1631, when Antonio Colmenero's famous *Curious Treatise of the Nature and Quality of Chocolate* made its first appearance, its author observed that the beverage was "much used in Spaine, Italy, and Flanders."[51] The same decade Dutch traders returned to Amsterdam with their first cargoes of Venezuelan cacao. In 1648 the renegade English Dominican Thomas Gage recounted for English readers his twelve years' pleasant experience as an imbiber of chocolate in Central America.[52] According to tradition, in 1651 a Spanish-born queen introduced the custom of chocolate drinking to the court of Louis XIV.[53] Six years later, on the eve of the Stuart Restoration, chocolate was first offered to the London public.[54]

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[40] Arcila Farias, p. 55. Statistics in this volume are expressed in terms of *fanegas* (bushels) of 110 *libras* each. The libra is slightly larger than the English pound (1.0143), but for the purposes of this study I have assumed they were of equal weight.

[41] The data summarized in Arcila Farias (pp. 45–48) suggest that internal consumption ranged between one-quarter and one-third of the total harvest, the amount doubtless varying with the size of the harvest, the attractiveness of external market prices, and the safety of sea lanes. Venezuelan cacao exports to Spain began in 1627 and from then until the end of the century totaled 71,595 fanegas (7,875,450 lbs.) but did not exceed 1,000 fanegas per year until 1663. *Ibid.*, pp. 55, 71–73.

[42] Arcila Farias argues (p. 53) that it was primarily the legal trade of Venezuela with New Spain rather than the illicit trade with the Dutch that served to promote the expansion of the cacao industry during the seventeenth and early eighteenth centuries. Unfortunately he supplies no documentation to support such a thesis. Hussey (also p. 53) is no more helpful. Although he states that "Many papers connected with this study prove that although Spanish America raised the world's supply of that commodity . . . Holland dominated trade well into the eighteenth century," he fails to cite his evidence. I have searched in vain for any reliable study concerning the role of the Dutch in the cacao trade. See, however, n. 72 below.

[43] On the reputation of Venezuelan cacao in the eighteenth and early nineteenth centuries, see Arcila Farias (pp. 42–44); Wood to Canning (cited in n. 33) and F[rançois] De Pons, *A Voyage to the Eastern Part of Terra Firme, or the Spanish Main . . . during the years 1801 [to] 1804* (3 v., New York, 1806) 2: p. 147.

[44] Calculations based upon Arcila Farias, pp. 61, 75–76. It will be noted that only partial statistics are available for eight years of the decade of the 1770's and omit shipments to Mexico during one of them (1773). The decennial average of 5,975,000 lbs. would probably be raised to 6,300,000 if data were available for the less important Venezuelan cacao centers.

[45] *Ibid.*, pp. 84–85; *De Pons, Voyage* 2: p. 346.

[46] Arcila Farias, pp. 81, 310–311.

[47] *Ibid.*, p. 61. The percentages of registered cacao exports sent to Spain amounted to 58 in the 1730's; 40 in the 1740's; 54 in the 1750's; 58 in the 1760's; and (on the basis of incomplete data) about 68 in the 1770's. The Szásdis (p. 30) estimate that in the late eighteenth century 60 to 70 per cent of the Peninsular cacao market was serviced by Caracas, the remaining 30 to 40 per cent by Guayaquil. Such an estimate fails to take into account the role of marginal exporters, such as the Portuguese Amazon.

[48] Chaunu, *Seville et l'Atlantique* 6, 2(1956): p. 1045.

[49] C. J. J. Van Hall, *Cocoa* (London, 1914), p. 4. Hussey, however, noted that by 1590 Luis (or Ludovicus) López's *Instructorium conscientiae,* in which the author

As already remarked, chocolate remained a luxury beverage in Europe and in the English mainland colonies during the seventeenth and eighteenth centuries. Cacao itself was expensive and the preparation of chocolate underwent a good deal of experimentation, especially during the seventeenth century. The early recipes closely resembled the bitter Indian drink and consisted basically of ground cacao beans, water, corn meal, vanilla, and chile pepper.[55] European confectioners also tried many other ingredients including salt, wheat flour, brandy, madeira, sherry, port, cinnamon, cloves, nutmeg, annatto coloring, several aromatic oils, almonds, boiled milk, beaten eggs, ambargrise, and "for young green Ladies," rhubarb.[56] By the turn of the eighteenth century, however, corn meal and peppers were generally omitted, and the recipe given for what was claimed to be the finest European chocolate consisted simply of "the largest Carack Nut . . . Wrought up with the finest Sugar, good Cinnamon, and the purest and best Vanillas."[57]

Improvements in its preparation together with more abundant supplies undoubtedly increased the European market for chocolate. It is difficult to measure in economic terms the consequences of the extravagant, often bizarre claims made for its consumption by enthusiasts during the seventeenth century who referred to chocolate as "the American Nectar," "The Indian Nectar," or "The Royal Liquor." Thomas Gage, for example, reported that he regularly drank two cups in the morning and another two in the afternoon and "when I was purposed to sit up late to study, I would take another . . . about seven or eight at night, which would keep me waking till about midnight." Following this routine, "I lived twelve years . . . healthy, without any obstructions or oppilations, not knowing what either ague or fever was."[58] Additional medical testimony came from Henry Stubbes, author of "The Indian Nectar, Discourse concerning Chocolata" (London, 1662) and king's physician in Jamaica 1661–1665. Dr. Stubbes declared that, if properly prepared, chocolate was "the best Diet for Hypochondriaks and Chronical distempers and Scurvy, Goute, and Stone, and Women lying in

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referred to cacao and to the mode of drinking it in Mexico, had been published in Venice. Hussey bibliography (see n. 3).

[50] Joan Rauch, *Disputatio medico-diatetica, de aëre et esculentia necnon de potû* (Vienna, 1622 and 1624), as described by Hussey (see n. 3).

[51] 1st ed., Madrid, 1631. An English translation appeared in London in 1640.

[52] Thomas Gage, *Travels in the New World,* ed. J. Eric S. Thompson (Norman, 1958), pp. 151, 158. Gage, whose first edition under a different title appeared in 1648, was not the first to bring the existence of cacao to the attention of English readers. See "A relation of the commodities of Nova Hispania . . . by Henry Hawkes merchant which liued 5 yeeres in the said County . . . 1572" and "A notable discourse by Master John Chilton . . . of the west Indies, seene and noted by himself in the time of his trauails . . . in the space of 17 or 18 yeeres," in Richard Hakluyt, *The Principall Navigations Voiages and Discoveries of the English Nation* (Facs. of the 1589 ed.; 2 v., Cambridge, Eng., 1965) **2**: pp. 547, 587–588. By the end of the sixteenth century, however, English knowledge of cacao and its source remained extremely vague. See John Gerarde, *The Herbal or Generall Historie of Plantes* (London, 1597), pp. 1363–1365.

[53] Van Hall, *Cacao,* p. 4, and Hussey, *The Caracas Company,* p. 53. De Pons, however, credits Alfonse de Richelieu, brother of Louis XIII's dominant minister, with being the first to introduce chocolate to France because of its presumed medicinal qualities.

[54] Walter Baker & Co., *Cocoa and Chocolate: . . .* (Boston, 1886), p. 39.

[55] Bergmann, "Cacao and its Production" (cited n. 7), p. 43; Baker & Co., *Cocoa,* pp. 34–35.

[56] John Nott, *The Cooks' and Confectioners' Dictionary* (London, 1723), p. CH, as quoted in Hussey bibliography (see n. 3 above). Additional recipes are given in the Chamberlayne article cited in n. 61 below.

[57] Pierre Pomet ("late Chief Druggist of Louis XIV"), *A Complete History of . . . Druggs . . . to which is added what is further observable on the same subject, from Messrs. Lemery and Tournefort* (1st ed., 1712; rev. ed., London, 1737), p. 131.

[58] *Travels,* p 157. Perhaps the earliest work to discuss the medicinal qualities attributed to cacao was Juan de Cárdenas, *Primera parte de los problemas y secretos* (Mexico, 1591), described in the Hussey bibliography (n. 3 above).

and Children new-born."[59] Even more all-encompassing were the boasts of Charles de Rochefort, author of an early account of North European settlement in the Caribbean. Said Rochefort,

> This drink taken moderately causeth Venergy, Procreation and Conception, and facilitates Delivery, preserves Health, and impinguates; It helpeth Digestion, Consumption and Cough of the Lungs, Plague of the Guts, and other Fluxes, the Green-Sickness, Jaundice, and all manner of Inflammations. . . . It cleanseth the Teeth, and sweeteneth Breath, provokes Urine, cures Stone and Strangury, expells Poyson, and preserves from all infectious Diseases.[60]

Finally, there is the account of John Chamberlayne, royal historian during the Restoration, who soberly reported "a notable Example of the Effect of Chocolate . . . [upon] a Man in desperate Consumption, who took a great Fancy for Chocolate; and his Wife, out of Complaisance drank it often with him; the Consequence was this, the Husband recovered his Health, and his Wife was afterwards brought to Bed of three Sons at one Birth."[61] Neo-Malthusians take note! By the end of the century medicinal claims for chocolate were becoming less common,[62] though during the eighteenth century it was sometimes touted as brain food for scholars.[63] By then it was widely consumed by upper-class Europeans and English colonials primarily because it was a pleasant, fashionable drink, a sign of gentility epitomized by Pietro Longhi's well-known dignified family portrait entitled "The Morning Chocolate."[64]

During the seventeenth century when the English, Dutch, and French successfully intruded into the Caribbean and established colonies on its islands and along the adjacent Guianian mainland, they responded to growing European interest in chocolate by planting cacao orchards in many of their colonies. But with rare exceptions their experience proved no more rewarding than it was for the Spaniards who also experimented with cacao on the Greater Antilles during the 1630's and 1640's.[65] When the English conquered Jamaica (1655), they found a number of newly established cacao plantations situated on the north side of the island.[66] Because of initially high profits and the relatively small capital investment required,[67] Jamaica witnessed a cacao boom that lasted into the early 1670's. By the beginning of that decade there were between 47 and 60 cacao walks (plantations) situated along the northern and south-central portions of the island, and Jamaica's annual harvest was estimated at 188,000 pounds.[68] Additional plantations were being laid out and a contemporary described cacao as "the principal and most beneficial commodity of the Isle."[69] Suddenly, however, the island was swept by some sort of mysterious "blast," apparently plant blight, and by 1673 the yearly harvest had been reduced to a mere 5,000 pounds.[70] The blast was the first of a series of calamities to befall Jamaican cacao growers,[71] and later attempts to revive the industry proved fruitless.[72] During the eighteenth and early nineteenth centuries Jamaica, along with several English islands in the Lesser Antilles, continued to produce insignificant quantities of cacao.[73]

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[59] [Henry] Stubbes, "Observations made . . . sailing from England to the Caribe-islands," Royal Society of London, *Philosophical Transactions* **37** (July 13, 1668): pp. 721–722. Sir Thomas Pope Blount, *A Natural History: Containing many not Common Observations: Extracted out of the best Modern Writers* . . . (London, 1693), p. 97, quotes Stubbes with approval.

[60] *The History of the Caribby Islands,* tr. and ed. John Davies (London, 1666), p. 38, as quoted in Robert C. Batie, "A Comparative Economic History of the Spanish, French and English on the Caribbean Islands during the Seventeenth Century" (unpublished Ph.D. diss., University of Washington, 1972), p. 80.

[61] [John Chamberlayne], "The natural History of *Coffee, Thee, Chocolate,* and *Tobacco:* . . . Collected from the Writings of the best Physicians and Modern Travelers," reprinted from a 1682 pamphlet in *The Harleian Miscellany: or a Collection of Scarce, Curious and Entertaining Pamphlets and Tracts* (London, 1744) **1**: pp. 518–520, at 520.

[62] See, however, Sloane, *Voyage* **2**: p. 17; and Edwards, *History of the British West Indies* **2**: p. 364n.

[63] Francisco Javier Llampillas, *Ensayo de la literatura española* (n.d. n.p. given), Hussey bibliography (cited n. 3 above).

[64] See Mueller, *Seltsame Frucht Kakao,* frontispiece; also plate XVI, facing p. 64.

[65] Batie, "Comparative Economic History," pp. 79–83.

[66] Sloane, *Voyage* **1**: p. lxxi. I infer that the Spanish plantations were of recent origin, since they are unmentioned in the comprehensive *Compendium* of Vázquez de Espinosa (cited n. 26), p. 117, par. 331. On the early English experience with cacao on Jamaica, see Carl and Roberta Bridenbaugh, *No Peace Beyond the Line: The English in the Caribbean 1624–1690* (New York, 1972), pp. 285–286, and Richard S. Dunn, *Sugar and Slaves. The Rise of the Planter Class in the English West Indies, 1624–1713* (Chapel Hill, 1972), pp. 168–171.

[67] The cost of establishing a cacao plantation of 500 to 600 acres on Jamaica was estimated by a contemporary at slightly more than £275, compared with *ca.* £5,000 for a sugar plantation of 1,000 acres. Richard Blome, *Description of the Island of Jamaica* . . . (London, 1672), p. 4, as quoted in Orlando Patterson, *The Sociology of Slavery. An Analysis of the Origins, Development and Structure of Negro Slave Society in Jamaica* (London, 1967). p. 20; *cf.* Dunn, p. 168, who calculates a much lower per acre cost figure but indicates anticipated profits amounted to as much as 54 per cent of the initial investment.

[68] Patterson, p. 19. The anonymous writer cited in n. 70 estimated the crop at between 200,000 and 300,000 lbs. per year. For an explanation of the term cacao walk, see De Pons, *Voyage* **2**: pp. 148–149.

[69] Blome, p. 4, as quoted in Patterson, p. 19.

The French also established cacao plantations in their major West Indian colonies, Martinique, Guadeloupe, and Saint Domingue [Haiti], as well as in Cayenne, but they too failed to attain enduring success. In the early 1660's the first cacao estates were laid out on Martinique and Guadeloupe with feral trees obtained from the indigenous forest.[74] No indications of the size of the yields obtained are available for years prior to the early eighteenth century. Between 1710 and 1722 cacao exports from Martinique doubled from 592,700 to 1,377,600 pounds per year, but in 1727 three-quarters of the trees were destroyed by an earthquake.[75] New stock, apparently the hardier *C. forastero*, was imported from Cayenne in the early 1740's and production stabilized at about the 1710 level. For unexplained reasons there appears to have been renewed interest in cacao on both Martinique and Guadeloupe beginning in the late 1760's. Exports from the former suddenly doubled between 1767 and 1769, averaging just over 1,200,000 pounds a year from 1769 to 1777 and 1,336,500 between 1782 and 1788.[76] Contemporaneously, the number of cacao trees planted on Guadeloupe increased from 134,000 in 1767 to 450,000 in 1777, suggesting an expected harvest of close to half a million pounds.[77] However, incomplete export figures for the years 1789–1792 suggest a drastic but unexplained contraction of the industry on the eve of the Revolution.[78]

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[70] Some writers have contended that the term "blast" referred to a hurricane, but it was apparently some sort of plant disease which occurs frequently when wild cacao trees are concentrated on plantations. Cuatrecasas (cited n. 5 above), p. 394. For an excellent discussion of this problem, see W. H. Johnson, *Cocoa: its Cultivation and Preparation* (London, 1912), pp. 76–113. The source of the blast clearly mystified contemporaries. See [Anon.], "An accurate Description of the Cacoa-tree, and the way of it's [*sic*] curing and Husbandry &c. given by an Intelligent person now residing in Jamaica," Royal Society of London, *Philosophical Transactions* **93** (Apr. 21, 1673): pp. 6007–6009. For a modern definition of the term, see *Oxford English Dictionary*, p. 6a.

[71] Others included a disastrous hurricane (1689), the Port Royal earthquake (1692) and a buccaneering raid (1694).

[72] One such attempt was Treasury authorization for one Peter Henriques "a merchant of London" probably of Portuguese origin to import 20 tons of cacao seed from Holland because the Dutch "had 'by some artifice imported of late great quantities of cacao from the Spanish West Indies which (with the scarcity of that commodity in Jamaica and the difficulty of having it from the Spanish as formerly) hath made it very scarce in this kingdom.'" Charles M. Andrews, *The Colonial Period of American History* (4 v., rpr. New Haven, 1964) **4**: p. 94 n. 2.

[73] Edward Long, *The History of Jamaica*, . . . (3 v., London, 1774) **3**: p. 695; Edwards, *History of the British West Indies* **2**: pp. 362–363, and **5**, appendix 32, listing cacao exports from British-held islands for 1816–1817. The total (887,200 lbs.) is inflated by the fact that the former Spanish island of Trinidad, British-occupied in 1797 and the source of 641,600 lbs. of cacao, is included. Occasional Jamaican cacao exports to the British mainland colonies are indicated in Frank Wesley Pitman *The Development of the British West Indies, 1700–1763* (New York, 1967), pp. 208, 303.

[74] Jean Baptiste Labat, *Nouveau voyage aux isles de l'Amérique* . . . (2 v., The Hague, 1724) **2**: pp. 351 f. *Cf.* Louis-Philippe May, *Histoire économique de la Martinique, 1635–1763* (Paris, 1930), pp. 94–95, who questions the tradition apparently begun by Labat crediting a Portuguese Jew, Benjamin Dacosta, with having been the first to plant cacao on Martinique.

Whether cocao was indigenous to the West Indies or was introduced after European contact remains a puzzle. Oviedo y Valdes (cited n. 8 above) explicitly states that "The tree called *cacao* or *cacaquat* is not of these islands but of the mainland. . . ." (Tomo II, Lib. 8, Chap. XXX, and Bergmann "The Distribution of Cacao Cultivation," p. 87) accepts his testimony as incontrovertible. However, in the 1570's Lopez de Velasco listed cacao among the "frutas silvestres" found in the islands (*Georgrafia* [cited n. 25 above], p. 95). In the late seventeenth century a French intendant on Martinique stated that cacao "est naturelle dans l'isle et a été trouvée dans le bois, . . ." Quoted in C[abuzel] A. Banbuck, *Histoire politique, économique et sociale de la Martinique sous l'ancien régime (1635–1789)* (Paris, 1935), p. 248. But his testimony does not conclusively prove pre-Columbian existence of cacao in the islands.

[75] May, *Histoire économique*, pp. 95–96, and 323, table 2. As early as 1708 the cabildo of Caracas expressed concern over "las grandes porciones de Cacao que han entrado en el referido Reyno [i.e., New Spain] asi del Guayaquil como de la Ysla Martinica . . . en grave perjuicio de esta Provincia y sus vecinos, . . ." Nuñez, *Cacao* (cited n. 29), pp. 123–125. See also Pierre Dardel, *Navires et marchandises dans les portes de Rouen et du Havre au xviii^{e} siècle* (Paris, 1963), p. 218.

[76] May, *Histoire économique*, p. 323, table 2.

[77] Eugène Edouard Boyer-Peyreleau, *Les Antilles françaises, particullièrement la Guadeloupe, depuis leur découverte jusqu' . . . 1825*, (2 v., 2d ed.,Paris, 1825) **2**: appendix 5.

Some time before the turn of the eighteenth century cacao was also introduced in Saint Dominique, probably from sources in the neighboring Spanish colony of Santo Domingo.[79] But in 1716 the trees were leveled by a hurricane, a setback from which the industry never appears to have recovered. In 1791, just before the onset of a series of devastating revolutionary upheavals, Saint Domingue's 69 cacao plantations bore an average valuation of 4,000 *livres*, compared with 230,000 for a sugar estate and 30,000 for an indigo works.[80]

Two decades before the turn of the eighteenth century the Dutch also began cacao cultivation (probably from stocks obtained from Trinidadian or Venezuelan sources) in one of their New World colonies, Surinam. Though small-scale exports started as early as 1702, they did not achieve significant levels until the second half of the 1730's. Between 1726 and 1741 eighty-seven cacao plantations were established along the lower margins of Surinam's principal rivers, and they appear to have remained the principal producers of Surinam cacao for the next century. But, as measured by Amsterdam prices, the quality of the Surinam product remained far below that of the Caracas standard.[81] While exports grew to over a half million pounds per year by the 1770's and increased to 620,000 pounds a year during the following decade, they represented less than 5 per cent of the value of the colony's coffee crop. After the 1780's the volume of the Dutch colony's cacao exports declined precipitously, as indicated by table 10.[82]

During the 1790's the level of exports by Europe's dominant supplier, Venezuela, reached their peak for the colonial era at 8.8 million pounds per year and the Prussian scientist Alexander von Humboldt estimated that the colony then had 16 million trees under cultivation.[83] By the end of the decade, however, the industry was in distress because access to Peninsular markets had been interrupted by a renewal of Anglo-Spanish maritime conflict (1796–1802; 1803–1808). That conflict compelled Venezuelan exporters to dispose of their stocks by selling them to British and Yankee purchasers.[84] Even so, the merchant guild (*consulado*) of Caracas complained in 1805 that exports had fallen by 52 per cent the previous year.[85] During the years 1800–1809 total exports appear to have diminished to about 6.2 million pounds per year, i.e., to the level attained during the decades of the 1750's through the

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[78] The first semester figures for 1789, 1790, and 1792 were respectively 10,000, 24,300, and 30,500 *livres*, which I have converted as approximately equal to the English pound. Boyer-Peyreleau, appendix 8.

[79] According to a 1691 report, "En tiempos pasados," presumably during the middle decades of the century, cacao had flourished on Santo Domingo but the trees had been destroyed by a plant disease called *alhorra*. Araujo y Rivera, "Descripción de la isla española," quoted in Emilio Rodríguez Demorizi, ed. *Relaciones historicas de Santo Domingo* (3 v., Ciudad Trujillo, 1942–1957) **2**: p. 303. At the end of the eighteenth century Moreau de Saint-Méry implied that cacao was more important in the Spanish part of the island than in the French. M. L. Moreau de Saint-Méry, *Descripción de la parte española de Santo Domingo*, tr. C. Armando Rodríguez (Ciudad Trujillo, 1944), pp. 98–99.

[80] Pierre F. X. de Charlevoix, *Histoire de l'isle Espagnole ou de S. Domingue*, . . . (4 v., Amsterdam, 1733) **2**: pp. 390–391. See also [Anon., attributed to Sir James Basket or Barskett], *History of the Island of St. Domingo from its Discovery . . . to the present. . . .* (London, 1818), pp. 102–103, 384, and appendix 3.

[81] Amsterdam quotations of Surinam cacao given in Posthumus begin in 1746 and average approximately one-third of the value of Caracas cacao. N[icolass] W[illelmus] Posthumus, *Inquiry into the History of Prices in Holland* (2 v., Leiden, 1946) **1**: pp. 197–199.

[82] Among the best contemporary descriptions of the eighteenth-century cacao industry in Surinam are Philippe Fermin, *Description génerale, historique, géographique et physique de la colonie de Surinam*, . . . (2 v., Amsterdam, 1769) **2**: pp. 59–71, and J[ohn] G[abriel] Stedman, *Narrative of a five years' expedition against the Revolted Negroes of Surinam; from . . . 1772 to 1777* . . . (2d ed., 2 v., London, 1806) **2**: pp. 214–215. The standard scholarly account, which is based entirely on printed sources, appears to remain A. Reyne, "Geschiedenis der Cacaocultuur in Suriname," *De West=Indische Gids* **6** ('S-Gravenhage, 1925): pp. 1–20, 49–72, 107–126, and 193–216. For export statistics given in Dutch pounds (=1.09 English pounds), see pp. 12–15.

[83] Arcila Farias (cited n. 37), pp. 307 and [312]; De Pons, *Voyage* (cited n. 43) **2**: p. 346; Alexander von Humboldt, *Personal Narrative of Travels to the Equinoctial Regions of America during the years 1799–1804*, tr. Thomasina Ross (3 v., London, 1852) **2**: pp. 57–62.

[84] See Dorothy B. Goebel, "British Trade to the Spanish Colonies, 1796–1823," *Amer. Hist. Rev.* **43** (Jan. 1938): pp. 288–320, esp. 288–304, and Frances Armytage, *The Free Port System in the British West Indies. A Study in Commercial Policy, 1766–1812* (London, 1953), pp. 101, 126–127. Useful as these studies are, they are distressingly devoid of concrete data concerning the volume of British trade with the Spanish empire.

[85] Resolution of the consulado, 23 February, 1805, in Eduardo Arcila Farias, ed., *El Real Consulado de Caracas* (Caracas, Instituto de Estudios Hispanoamericanos, 1957), p. 242.

1770's.[86] But in 1810 the long series of bitter campaigns for independence began. Apart from the effects of rival royalist and patriot coastal blockades, the cacao industry suffered particularly because of destructive campaigns waged in cacao-producing districts and the dispersal of its slave labor force.[87] It is not surprising, therefore, that annual exports during the decade 1810–1819 fell by half and averaged about 3 million pounds per year (see table 10).[88]

The decline of Venezuelan cacao exports made it necessary for European buyers to seek new sources of supply. One of the chief beneficiaries of Venezuela's distress was a hitherto marginal cacao producer, the Portuguese Amazon. The Amazon had long been a backwater of the Portuguese empire.[89] Discovered between 1499 and 1542, its first European settlements were established along the littoral early in the seventeenth century, beginning with the founding of its chief port, Belém do Pará, in 1616. By the early eighteenth century the European presence was represented by a handful of primitive settlements, impoverished plantations, and livestock ranches concentrated toward the mouths of the great river,[90] by several strategically located river forts which served chiefly as traffic checkpoints, and by upwards of fifty missions, the responsibilities of the Jesuits, the Franciscans, the Mercedarians, and the Carmelites. Apart from priests and indigenous inhabitants, the Amazon's population consisted of small contingents of European soldiers, convicts (*degredados*), subsistance farmers, and a few government officials. About 1700 Belém, by far the largest settlement in the area and often administrative center of all of northern Brazil (i.e., the old State of Maranhão), boasted a mere 500 inhabitants, but that figure grew to 2,500 by midcentury.[91] Between 1750 and the end of the 1770's estimates of the European-controlled population in the two major administrative districts of the Amazon, the captaincy of Grão Pará and the subordinate captaincy of Rio Negro, ranged from 40,000 (1750) to nearly 70,000 (1779).[92] Most of these people were tied to a barter economy, for until 1749, when the crown finally yielded to long-standing appeals from the colony for shipments of metallic currency from the royal mint in Lisbon, the only available media of exchange consisted of locally produced cotton balls and cacao seed.[93]

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[86] Venezuelan export statistics for the years 1800-1820 have not been published. Consequently, this estimate is based upon an analysis of United States and British cacao import data for these years. It assumes that nearly all the cacao that entered United States ports between 1794 and 1811 originated in Venezuela. See Timothy Pitkin, *A Statistical View of the Commerce of the United States* (Hartford, 1816; rpr., New York, 1967), p. 317 and n. 88 below. For the years 1806–1815 British cacao imports are given in a continuing series generally entitled "An Account of the Official or Rated Value of all Imports into Great Britain . . . during the last Seven Years . . . ," in *The Journal of the House of Commons* **63**: pp. 702, 704; **64**: pp. 548, 550; **65**: pp. 647, 650; **66**: pp. 595, 597; **68**: pp. 805, 807; **70**: pp. 685, 687; and **71**: pp. 801, 803. The totals are expressed in sterling according to the official values established in 1694, rather than by weight. To obtain quantities, I have divided by the official value set for cacao. See Werner Schlote, *British Overseas Trade from 1700 to the 1930's* (Oxford, 1952), p. 155, table 2. In fact, the official value (£2 s. 10/cwt.) was considerably lower than current cacao prices which were estimated at £4. s. 10/cwt. by Inspector-General of Customs Thomas Irving in his "An account of the Value, estimated agreeably to the Prices Current, of Goodes, Wares, and Merchandize imported into great Britain from all parts of the World, on an Annual Average of Three Years preceding the 5th January 1799; . . ." in Great Britain, House of Commons, *Sessional Papers* **49** (1800): p. 981. From the gross import results thus obtained, I have subtracted the annual average imports from Portuguese and British West Indian sources. See tables 7 and 10 below.

[87] John V. Lombardi, *The Decline and Abolition of Negro Slavery in Venezuela, 1820–1854* (Westport, Conn., 1971), pp. 96–97.

[88] For United States cacao imports and re-exports to 1817, in addition to Pitkin (see n. 86 above), see Adam Seybert, *Statistical Annals . . . of the United States of America: . . .* (Philadelphia, 1818), pp. 192–193, 264–265. Venezuelan cacao exports in 1820 were reportedly 5,280,000 pounds, but this total may have included more than one year's crop, for the estimated exports for 1824 were put at 3,883,000. Thomas Tupper to George Canning, 21 Feb., 1824, Humphreys, ed., *British Consular Reports* (cited n. 33), p. 275. Venezuelan exports from 1831 to 1855 are given in Lombardi, p. 165, table 2. As indicated, they failed to reach the 1790 levels until about 1840, though before then many planters began converting from cacao to the production of coffee.

[89] As employed throughout the balance of this study, the Amazon includes the present Brazilian states of Pará and Amazonas and the territories of Amapá and Roraima.

[90] Although dated in certain respects, J[oão] Lúcio d'Azevedo, *Os Jesuitas no Grão-Pará. Suas missões e a colonização* (Lisbon, 1901) remains indispensable. See particularly chaps. VI and VIII. As late as 1782 there were only fifteen settlements in northern Brazil (i.e., the present states of Maranhão and Piauí and those states and territories indicated in n. 89 above), nine along the coast and six in the interior of the Amazon Valley. João Vasco Manoel de Braun, "Roteiro da viagem . . ." (1782), BNL/FG, No. 568, fl. *2* v.

[91] José de Sousa Ferreira, "Noticiario maranhense. . . ." (early 1700's), *Revista do Instituto Histórico e Geográfico Brasileiro* **81** (1917): p. 302; António Ladislau Monteiro Baena, *Compêndio das eras da provincia do Pará* (1st ed., 1838; rpr., Belém, 1968), pp. 157–158.

[92] In all probability the earliest count of the Amazon's population was an episcopal census completed in 1730. Bishop of Pará to king, Sept. 19, 1730, AHU/PA, Pará, cx. 6 (orig.), a covering dispatch for a now

As elsewhere, the origins of cacao exploitation in the Amazon remain obscure.[94] The appearance of cacao trees along the route of the celebrated Francisco de Orellana, the so-called "discoverer" of the Amazon who was seeking the "Land of Cinnamon" in 1542–1543, evidently did not impress that leader or his literate followers, for they are unmentioned in that expedition's surviving documentation.[95] Nor does cacao appear to have interested those obscure English, Dutch, and Irish colonists who established ephemeral plantation colonies in the lower Amazon during the first quarter of the seventeenth century.[96] However, when the Spanish Jesuit Cristobal de Acuña published his famous *New Discovery of . . . the Amazons* (Madrid, 1641) reporting his observations in the valley during his recent descent from Quito to Belém, he identified wild cacao as one of the "four products which, if cultivated, would undoubtedly be sufficient to enrich not only one, but many kingdoms." He added that "There is scarcely any difference between this tree, and that which yields this much valued fruit in New Spain [i.e., Guatemala] . . . It is clear that with little labour these trees may be cultivated on this river, when, without any help from art, nature alone covers them with abundance of fruit." [97]

Since Father Acuña's account was quickly suppressed by an alarmed Spanish government,[98] it is unlikely that it exerted any influence upon the beginnings of cacao exploitation in the Amazon. The earliest definite indications that we possess concerning the deliberate cultivation of cacao in the Amazon date from the 1670's.[99] According to a dispatch from the prince regent (later King Pedro II) of Portugal, the first person to plant cacao in the area was one João de Ornellas da Câmara who had previously acquired knowledge

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unfortunately missing enclosure. The 1750 estimate was that of Francisco Pedro de M[endon]ça Gorjão (governor) to king, Aug. 13, 1750, *ibid.*, Pará *maço* 1. AHU/PA/Pará, cxs. 27, 33, 35, 38, and 39 contain census reports from 1765 to 1779.

[93] As early as 1708 the municipal authorities of Belém appealed to the king to send specie supplies to northern Brazil because of the "inconveniences" that colonists experienced without it. Câmara of Belém to king, July 26, 1708, AHU/PA/Pará, cx. 3 (orig.). The governors of the captaincies of Pará and Maranhão repeatedly supported the settlers' appeal for a regular supply of specie and the Overseas Council, the chief directing agency of the Portuguese empire, endorsed such requests, but it was not until 1748 that the first shipments of coin from the Lisbon mint were authorized for northern Brazil. João de Abreu de Castelbranco (governor of Pará) to Cardinal da Mota, Oct. 14, 1738, AHU/PA/Pará, cx. 10; Overseas Council to king, 4 Mar. 1741, AHU/PA/Maranhão, cx. 31 (orig.): Baena, *Compêndio*, p. 157. Three-quarters of a century later an English naval officer who toured the Amazon valley concluded that "the want of a circulating medium" remained one of the major economic handicaps of the area. Henry Lister Maw, *Journal of a Passage from the Pacific to the Atlantic descending the River Marañon, or Amazon* (London, 1829), pp. 405–406.

[94] For another account of the beginnings of Amazonian cacao extraction, see Manuel Barata, *A antiga produção e exportação do Pará. Estudo historico-economico.* (Belém, 1915), esp. pp. 11–13. The only recent study is Manuel Nunes Dias, "As frotas do cacao da Amazônia (1756–1777): subsídios para o estudo do fomento ultramarino português no século xviii" (hereafter cited as Dias, "Cacao"), *Revista de historia* [*de*] *São Paulo* (hereafter cited as *RHSP*) **24**: pp. 363–377, which reproduces much of the same author's earlier and broader study, "O cacau luso-brasileiro na economia mundial—subsídios para a sua historia," *Studia* (Lisbon, Centro de Estudos Históricos Ultramarinos, July, 1961) **8**: pp. 7–93, but the author is seemingly uninterested in the first seventy five years of the industry.

[95] See *The Discovery of the Amazon according to the Account of Friar Gaspar de Carvajal and Other Documents . . .*, introd. by José Toríbio Medina, tr. Bertram T. Lee, ed. H. C. Heaton (New York, 1934).

[96] James A. Williamson, *English Colonies in Guiana and on the Amazon, 1604–1668* (Oxford, 1923), *passim*.

[97] Clements R. Markham, tr. and ed., *Expeditions into the Valley of the Amazons, 1539, 1540, 1639*, Hakluyt Society, *Works*, 1st. ser., **24** (London, 1859): pp. 67 and 76.

[98] It will be remembered that in December, 1640, the Portuguese began their successful rebellion against the sixty-year old Spanish hegemony of Portugal and her empire.

[99] Several writers have noted that in 1665 Dom Vasco Mascarenhas (Conde de Óbidos), viceroy of Brazil, wrote the captain major of Pará to send him cacao plantings and advice concerning how they should be cultivated (Óbidos to Paulo Miz Garro, Bahia, Apr. 24, 1665, Biblioteca Nacional, Rio de Janeiro, 8, 1, 3, fls. 44–44 v., for which reference I am indebted to Professor Stuart B. Schwartz, Department of History, University of Minnesota). But I know of no evidence that such a shipment was actually sent or that cacao was cultivated in the Amazon that early. On the other hand, small quantities of wild cacao may well have been gathered at various points in the Amazon by the early 1670's. In 1673 an anonymous writer on Jamaica reported that ". . . I am informed the Portuguese have lately discover'd whole Woods of it [cacao] up the River of Maranon." "An accurate Description of the Cacao-tree" (cited n. 70), p. 6009.

of cacao culture "in the Indies of Castile, where he was shipwrecked on a voyage from this Kingdom." [100] Other sources attribute the birth of the cacao industry to the activities of certain Jesuit fathers.[101] Whatever the truth, the fiscally hard-pressed Portuguese government did encourage cacao exports by means of a series of measures announced between 1678 and 1681.[102] It ordered the establishment of demonstration orchards near Belém so that settlers could inform themselves concerning the best methods of cultivating cacao; it freed royal officials from the customary ban against their participation in commerce by allowing them to export cacao on their own accounts; and, in 1681, it declared cacao exports exempted from all customs duties for the next six years and liable for half duties for an additional four years. In addition, it authorized members of the religious orders active in the valley to send to the kingdom substantial quantities of cacao free of all duties.[103] After learning that a local resident was manufacturing chocolate, the crown instructed the governor to expend royal funds to purchase several hundred pounds of his product.[104] But in spite of such measures, the government's efforts to spur a cacao industry in the Amazon were not crowned with success. In 1691 Pedro II lamented the colonists' waning interest in cacao production and directed the governor of Grão Pará to send cacao and other so-called "spices" by every homeward-bound ship.[105]

For reasons to be examined later, cacao did not become a significant export from the Amazon for another three and a half decades.[106] When sizable exports did begin, they came primarily from feral rather than cultivated sources. The latter would appear to possess significant advantages over the former. As is the case in other parts of the New World, cultivated cacao (called *cacao manso* in Brazil) in the Amazon yields two annual crops. The first and smaller one, termed the "summer" or "monkey" (*safra dos macacos*) harvest in the Amazon because of its attraction to such anthropoids, begins in January and February and continues to the end of March or early April. The second or "winter" harvest then begins immediately and lasts until August.[107] Feral or "wild" cacao (*cacao bravo* as the Portuguese referred to it) produces only a summer crop whose yield is lower and whose fruit is more bitter, and therefore less valuable, than the cultivated forms.[108]

The persistence of dependency upon feral cacao, one of the distinguishing features of Amazonian cacao production during the eighteenth and early nineteenth centuries, may be explained by several considerations. One was custom. The Portuguese had long been used to gathering resources they wanted from the Amazonian rain forest. Since at least the second quarter of the seventeenth century they regularly sent canoe-borne collecting parties upriver after what had long been the river's most prized resource—human bodies. Such parties, often accompanied by soldiers and missionaries, searched for captive Indians held by enemy tribes; in exchange for trade goods, they ransomed the captives in order to satisfy their needs for labor.[109] Because the use of the canoe was indispensable in the Amazon and because the Indians possessed an unrivaled knowledge of the plant resources of the valley, the dispatch of spice-collecting expeditions was an obvious extension of an already existing trade mechanism.[110] Second, cacao bravo appeared to be omnipresent. As Father Acuña observed, it grew throughout the interior of Amazonia. It was found along the banks and the adjacent islands of the main river, both in its lower reaches near Belém and especially between its confluence with the Rio Tocantins and the upriver ports of Óbidos and Santarém, as well as along the margins of its major tributaries, particularly the Rio Negro, the Rio Trombetas (where Orellana had his encounter with the Amazons), the Madeira, and the Solimões. Third, apart from the discouraging fact that planted cacao did not begin to yield a crop until the fifth year, the establishment of plantations involved expenses for which the returns—until the 1730's—were distinctly uncertain because of shipping and other problems to be discussed later. Finally, Indian labor was neither sufficiently abundant nor dependable. The Indians did not adapt well to regimented manual labor and, as elsewhere in the New World, were prone to desert; consequently shirking costs were extremely high.[111] By contrast with the perils of plantation production, the only significant outlay for the dispatch of a collecting party was the cost of a canoe, some 300,000 réis in the 1730's (approximately £80, or about one-third the value of a canoe-load of cacao sold in Belém during that decade).[112]

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[100] Prince Regent to Ignácio Coelho da Silva (governor of Maranhão), Jan. 13, 167[9], "Livro grosso do Maranhão," *Anais da biblioteca nacional do Rio de Janeiro* (hereafter cited as *ABNRJ*) **66** (Rio de Janeiro, 1948): p. 47. This two-volume collection (vol. **67** is the continuation) hereafter cited as *LGM*.)

[101] *Cf.* Serafim Leite, S. J., *Historia da companhia de Jesús no Brasil,* (10 v., Lisbon, 1938–1950) **4**: pp. 158–161.

[102] Apart from several burdensome diplomatic settlements in the 1660's, the crown's fiscal problems were related to the slump in prices for Brazilian sugar beginning about 1670.

[103] Prince Regent to various royal authorities, Dec. 1, 1677 to Aug. 20, 1681, *LGM* **66**: pp. 41–42, 46–47, and 60; Sousa Ferreira, "Noticiario" (cited n. 91), p. 321; *provisão* of Jan. 7, 1698, AHU/PA/Pará, cx. 14.

[104] Pedro II to Arthur de Sá e Menezes, May 4, 1688, *LGM* **66**: pp. 102–103.

[105] Same to António d'Albuquerque Coelho de Carvalho, Feb. 10, 1691, *ibid.*, pp. 115–116. Besides cacao, such spices (*drogas*) included vanilla, two varieties of cloves, cinnamon, and sarsparilla.

[106] Prior to the late 1720's there are occasional references to cacao, such as Thomas do Couto to Miguel Cardozo (procurator general, Society of Jesus), Belém, 6 Aug., 1713, BNL/FG, cod. 4517, fols. 422r.–423v. (reporting a shipment of eight sacks), and two accounts of the Jesuit college in Belém for 1714 and 1715, indicating small shipments to Bahia and Lisbon in 1713 and 1714. Leite, *História* **4**: pp. 384–385.

[107] Paul Le Cointe, *L'Amazonie brésiliene; . . .* (2 v., Paris, 1922) **2**: pp. 123–125; William M. Herndon, *Exploration of the Valley of the Amazon, . . .* (Washington, D. C., 1954), p. 295. Each growing area applied local terms to the two crops. In Venezuela, for example, the June crop was called the harvest of San Juan, while that which matured at Christmastime was referred to as the crop of the Nativity. Baker & Co., *Cocoa* (cited n. 54), p. 18.

[108] J. B. von Spix and C. F. P. von Martius, *Viagem pelo Brasil,* tr. Lúcia Furquim Lahmeyer (4 v., Rio de Janeiro, 1938) **3**: pp. 218–219; Humboldt, *Personal Narrative* **2**: p. 422.

Collecting parties (*tropas*) customarily left their base of operations—a mission station, a river port, or the city of Belém—in December or January. They consisted of one or more large, partly canopied canoes capable of carrying as much as 300 to 500 arrobas (each 32 pounds) of cargo, commanded by a white or mixed blood boat master (*cabo*) who supervised a crew of one to two dozen Indian paddlers.[113] After reaching an appropriately central site, the party constructed a thatched hut over a drying rack where the cacao would be temporarily stored. Members of the party then proceeded to collect fruit from stands of trees along the banks or dispersed over several miles of the jungle interior. When a load had been gathered, usually within six to eight days, they returned to the deposit, unloaded, and then resumed their "harvesting." Some time in March, if the harvest had been good, the tropa returned to its point of origin, but if the cabo was dissatisfied with the size of the haul, he directed the party to gather another spice, generally either so-called cloves (*cravo*) or sarsparilla. Once the tropa completed its collections, it headed down river, pausing eight days before its arrival in Belém at the island fortress of Gurupá, where the size of the cargo was recorded and taxed.[114] Upon reaching Belém in June or July, the crew was paid off and the boat commander received his share of the cargo, customarily 20 per cent.[115]

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[109] The ransoming system is thoroughly described in Mathias C. Kiemen, O.F.M., *The Indian Policy of Portugal in the Amazon Region, 1614–1693* (Washington, D. C., 1954), *s.v.* index under "Resgates."

[110] The earliest reference that I have seen to a cacao collecting expedition dates from 1696, but it is clear from the context that the practice was already well established. See *Journal of the Travels and Labours of Father Samuel Fritz in the River of the Amazons between 1686 and 1723,* ed. and tr. George Edmundson, Hakluyt Society, *Works,* ser. 2, **51** (London, 1922): pp. 95–96.

[111] Although this statement is based primarily upon manuscript sources too numerous to cite, it is supported by the findings of Colin MacLachlan. See particularly his "The Indian Labour Structure in the Portuguese Amazon, 1700–1800," in: D. Alden, ed., *Colonial Roots of Modern Brazil . . .* (Berkeley, 1972), esp. p. 217.

[112] The average cost of a canoe during this decade is given in Santos to [Cardinal da Mota], 10 Sept., 1734, cited n. 150 below. Sterling equivalents given in the text are based upon H. E. S. Fisher, *The Portugal Trade: A Study of Anglo-Portuguese Commerce 1700–1770* (London, 1971), appendix 6. The calculation offered in the text assumes a canoe-load of 300 arrobas (each 32 lbs.) valued at 4,800 réis per arroba, less 20 percent for the boatmaster.

[113] The canoes used on the Amazon were among the largest employed in colonial America. Among other observers, the French scientist la Condamine was impressed by their magnitude: "Les canots dont se servent les Portugais . . . sont beaucoup plus grands & plus commodes que les conots Indiens avec lesqueles nous avions navigué dans les Missions Espagnoles (i.e., of Quito)." Charles Marie de la Condamine, *Relation abrégée d'un voyage fait dans l'intérieur de l'Amérique meridionale . . .* (Nouvelle ed., Maestricht, 1778), pp. 88–89. One eighteenth-century bishop of Belém reported having seen some that measured 30 by 3.5 feet. D. Fr. João de São José, *Visitas pastorais. Memórias (1761 e 1762, 1763)*, annotated by Basílio de Magalhães and Cândido Jucá Filho (Rio de Janeiro, [1961]), p. 150. Cargo capacities of such craft are given in câmara of Belém to king, 19 July, 1704, AHU/PA/Pará, cx. 3, and in Francisco Xavier de Mendonça Furtado to José Ant.o Landi, 2 Aug., 1757, BNL/CP, cod. 162, f. 84.

[114] Canoes proceeding upriver to undertake spice collections were obliged to display a license obtained from the governor of Pará. The island fortress of Gurupá was established in conformity with the *alvará de lei* of 23 Mar., 1688, LGM **66**: pp. 87–88; for its location, see Sousa Ferreira, "Noticiario" (cited in n. 91), p. 300.

Although the amount of investment was relatively small when compared with the potential returns, these expeditions were nevertheless risky ventures. Boat commanders not infrequently saw their crews desert and sometimes become decimated as a result of encounters with hostile Indians or with poisonous reptiles which lurked amidst the cool, shady cacao canopies.[116] Sometimes the cacao was picked too green and proved unmarketable. Adulturation by boat commanders and others was far from being a rarity.[117] And because of inadequate drying and storage facilities, freshly collected cacao often rotted and spoiled before reaching overseas markets.[118]

Such problems persisted as long as the Amazon was a commercial source of cacao and their existence during the early eighteenth century does not fully explain why the industry failed to develop as rapidly as the crown had hoped. Certainly one serious handicap that confronted local exporters, particularly during the first quarter of the eighteenth century, was the shortage and irregularity of shipping service between Belém and Peninsular ports. Whereas twenty to forty large ships a year called at Brazil's major sugar ports, Recife, Salvador, and Rio de Janeiro,[119] often a year or more elapsed before one or two ships put in at Belém.[120] And those that did appear charged freight rates that were as much as 100 per cent of the f.o.b. value of the commodities themselves, three times greater than the rates that prevailed on the runs between the sugar ports of Brazil and the Peninsula.[121] Although officials in Belém protested against such discrimination, the existence of heavy freight charges and the scarcity of shipping were both reflections of the small volume of cargo available for export at Belém. And, as Ralph Davis has so wisely written, "what really mattered to the shipowner [during the seventeenth and eighteenth centuries] was weight and volume, not value. What created demand for shipping was mass, not price." [122] But what prompted mass was the existence of markets.

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[115] The foregoing is based upon Overseas Council to king, 12 Jan., 1712, AHU/PA/Maranhão, cx. 13 (orig.); see also, Francisco Xavier Ribeiro de Sampaio, "Appendice ao diario da viagem que em vizita, e correição das povoações da capitania de S. Jozê do Rio Negro fez o ouvidor e intendente geral da mesma, . . . no anno de 1774–75," *Anais da bibliotheca e archivo público do Pará* (hereafter cited as *ABAPP*) **6** (Pará, 1907): p. 82, and especially "Formalidade q' se costuma observar . . . pelos cabos das canoas . . ." (*ca.* 1780), AHU/PA/ Pará, cx. 42, summarized in Colin M. MacLachlan, "The Indian Directorate: Forced Acculturation in Portuguese America (1757–1799)," *The Americas* **28** (Apr., 1972): pp. 373–374.

[116] Overseas Council to Christóvão da Costa Freire (governor of Maranhão), 8 Feb., 1717, *LGM* **67**: pp. 147–148; Francisco Pedro de M.a Gorjão to king, 22 Apr., 1749, AHU/PA/Pará, cx. 3. On problems posed by encounters with snakes, see Henry Walter Bates, *The Naturalist on the River Amazons* (Berkeley, 1962), p. 88.

[117] The practice of mixing green with cured beans was condemned by Governor João de Abreu de Castelbranco in his dispatch of 28 Oct., 1737, to the king, AHU/PA/ Pará, cx. 9 (orig.). See also Azevedo, *Os Jesuitas no Grão-Pará*, p. 134. Adulturation was a common problem wherever cacao was valued. In the West Indies, for example, Bryan Edwards complained of cakes of chocolate "which appear to me to be composed of not more than one-half genuine cacao; the remainder I take to be *flour* [*sic*] and Castile soap." *History of the British West Indies* **2**: p. 364n.

[118] The dispatches of Pedro da Fontoura Carneiro (commissioner general of the *bula da cruzada* tax in Lisbon) to his agent in Belém, 18 Aug., 1748, to May, 1756 (BNL/CP, cod. 109, fols. 66v.–157v.) are filled with complaints concerning the repeated arrival of shipments of rotted cacao. Spoilage was also a problem in other cacao-growing regions. See n. 33 above.

[119] Charles R. Boxer, *The Golden Age of Brazil, 1695–1750* . . . (Berkeley, 1962), pp. 351–353; see also, José da Silva Lisboa to Domingos Vandelli, Salvador, 18 Oct., 1781, *ABNRJ* **32** (1914): p. 504.

[120] The irregularity of shipping service prompted one petitioner to propose that the king dispatch from Lisbon one 40-gun frigate each year to Belém to load cargo. Miguel Alonso Bravolt [?] to king, 8 Sept. 1702, AHU/ PA/Pará, cx. 3. As late as 1734, a royal investigator advised that because of insufficient shipping the accumulated stocks of cacao in Belém had reached 40,000 arrobas (1,280,000 lbs.). Santos to [Mota], 10 Sept., 1734 (cited in n. 150 below). In 1747 the royal treasurer of Pará reported that "por causa da muita demora dos Navios se achavao' os generos da terra damnificados, principalmente o cacao . . ." Quoted in Overseas Council to king, 22 May, 1748, AHU/PA/Pará, cx. 12 (orig.). Additional testimony concerning shipping shortages appears in the notes below.

[121] Câmara of Belém to king, 2 Aug., 1711, AHU/PA/ Pará, cx. 4. The council complained that since 1710 shipmasters had increased their charges for cacao from 500 réis/arroba to 900 and were threatening to raise them to 1,000. For freight rates that prevailed at this time between Brazil's major ports and the kingdom, see André João Antonil [pseud. for João Antonio Andreoni], *Cultura e opulencia do Brasil por suas drogas e minas* (1st ed., 1711), tr. and ed. Andrée Mansuy (Paris, 1968), p. 278. Price movements of sugar and cacao for part of the eighteenth century are shown comparatively in figure 3 below. According to Antonil, in 1711 the freight on Bahian sugar was about 329 réis/arroba. Between 1740 and 1765 it varied from 300 to 400 réis, and the sugar interests contended that it was too high to enable them to compete favorably in continental markets with English and French Caribbean competitors. In 1766 the crown established new and lower rates for sugar and tobacco (250 réis/arroba); tanned (320 each), raw (150 each), and half hides (150 réis each). Alvará of 29 Apr., 1766, *Colecção das leys, decretos, e alvarás que comprehendo o . . . reinado de . . . D. Joze o I* . . . **2** (Lisbon, 1771): pp 243–244. Whether such rates also applied to the then separately administered State of Maranhão is unclear.

The development of demand for shipping, and therefore for cacao, depended upon the discovery of markets for the Amazonian product. Since the taking of chocolate did not become fashionable in Portugal until at least the mid-eighteenth century,[123] such markets had to be found outside the kingdom. One was doubtless Italy, long a leading customer of Portugal, a large consumer of chocolate, but without its own tropical source of supply.[124] Some, but probably not much, entered French ports, though France, of course, possessed Caribbean sources of her own.[125] Possibly none reached England until the last decades of the century. During most of the eighteenth century the principal market for Amazonian cacao was very likely Spain. Here, Humboldt provides an important clue when he observed that it was common practice among chocolate manufacturers in Spain to mix a quarter of the cacao of Caracas with three-quarters of the inferior Guayaquileño product. But, he noted, because of the consequences of the wars of the 1790's and their continuation during the early years of the nineteenth century, Peninsular buyers had been blending Guayaquil cacao with "an inferior quality, such as that of Marañon [as the Spaniards called the Amazon], the Rio Negro, Honduras, and the island of St. Lucia [which] bear the name, in commerce, of Guayaquil cacao." [126] Though the Prussian was writing about commercial practices in the late eighteenth and early nineteenth centuries, there is good reason to believe that they also obtained much earlier. Furthermore, prior to the opening of direct trade between the Pacific coast of South America and Spain in 1740, Guayaquil cacaos were not shipped to Spain, so that low-grade types must have come from another source. There is evidence that points to the Portugese Amazon as that source.

In 1717 the Spanish government issued an edict barring the entry within its dominions of "cacao de Marañon que venian de Portugal[*sic*]," that is, Amazonian cacao which came from Portugal. This was the first of a long series of similar warnings. In 1730 a Spanish report stated that considerable quantities of such cacao were being smuggled into Spain from Portugal, and another in the 1740's contended that the Portuguese were selling their cacao under the name of Cayenne cacao. Prohibitions against admission of Portuguese cacao were renewed by Spanish authorities as late as the 1760's, but nearly a quarter-century later the directors of the Caracas Company claimed that their Peninsular market had been "destroyed by quantities of so-called Cayenne cacao brought in by French and Spanish traders." According to Roland Denis Hussey, "Though this included much from Marañon, strickly banned from Spain, no action resulted from the directors' complaint." [127]

Several sources trace the beginnings of the cacao boom in the Amazon to the year 1725 and by that date a dependable market for the Amazonian product presumably existed. Writing a quarter-century later, the municipal council of Belém observed that shipping service began to improve that year because of the abundance of cacao.[128] And in the late 1730's a royal governor credited his distinguished predecessor João da Maia de Gama (1724–1728) with having first given impetus to the cacao industry in 1725.[129] Corroboration comes from the pen of Maia da Gama himself, for he reported that he had been zealously promoting the planting of orchards of cacao and cloves.[130] Certainly he had good reason to take a keen personal interest in the increase of cacao exports, for in 1723 the crown had notified him that in the future payments of his own salary depended upon the remission of an equivalent value of cacao to Lisbon each year.[131] That policy was continued at least during the next administration, even though the new governor protested his inability to meet the required quota because much of the domestic crop had been lost as a result of excessively heavy rains.[132]

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[122] *The Rise of the English Shipping Industry in the Seventeenth and Eighteenth Centuries* (London, 1962), p. 176.

[123] By midcentury cacao was clearly a fashionable beverage among the Portuguese gentility, and the newly arrived governor, Francisco Xavier de Mendonça Furtado, included boxes of cacao along with coffee in his list of personal gifts to prominent friends in Portugal. "Rellação das encomendas do Illmo. e Exmo. Sr. Gn^{l}.," n.d. (*ca.* 1752), BNL/CP, cod. 630, f. 119r. (orig.).

[124] See the reference to the 1727 voyage of the *St. Quinton* between Lisbon, Cadiz, and Genoa in Davis, *Rise of English Shipping*, p. 249. For later Italian imports of cacao from Portugal, see table 7 below.

[125] Dardel, *Navires et marchandises* (cited in n. 75), p. 220.

[126] *Personal Narrative* (cited in n. 83) **2**: p. 61.

[127] The preceding paragraph is based on Erneholm, *Cacao Production* (cited in n. 4), pp. 60–62, and Hussey, *Caracas Company* (cited in n. 37), pp. 185, 293.

[128] Baena, *Compêndio* (cited in n. 91), p. 157.

[129] João de Abreu de Castelbranco to king, 7 Oct. 1737, AHU/PA/Maranhão, cx. 21 (orig.).

[130] Overseas Council to Maia da Gama, 18 Nov.,

We have no reliable information as to the number of cacao trees actually being cultivated by the early 1730's, though one writer confidently asserts that they numbered 1,500,000.[133] Significantly, he supplies no documentary support and the claim appears specious, for it is clear that the primary means by which Maia da Gama and his successors spurred cacao production was by relaxing the licensing system which authorized canoes to proceed upriver to gather wild cacao. Between 1723 and 1729 the number of such licenses increased from 80 to 110 per year; by the early 1730's, the yearly average stood at 250, and by 1736 it reached 320. So great had the rage to participate in such ventures become that a worried royal magistrate reported that "there is not a substantial citizen, a cultivator, or a frontiersman who does not utilize this liberality [i.e., the relaxation of licensing restrictions] to send a canoe to extract spices and other commodities that the backlands produce." Whole Indian villages, he charged, were being drained of their population to provide manpower for the tropas and the trees were being indiscriminately stripped of their fruit before they had ripened, so that as much as two-thirds of the beans reached Belém green and unmarketable. Since cacao had now become the Amazon's principal media of exchange, the judge considered those who attempted to peddle green beans to be, in effect, counterfeiters.[134]

The Overseas Council took due note of this sobering report. But it contented itself with a warning to the governor not to permit more canoes to proceed to the interior than the available supplies of manpower warranted. It stipulated that persons guilty of the sort of crimes described by the judge be barred from participating in the collecting expeditions for ten years.[135] However, it is doubtful that such a penalty was ever assessed, for the boom continued to gain in momentum in succeeding years.

By the early 1730's cacao had become the Amazon's dominant export staple, a position it would continue to occupy for longer than a century.[136] The years between 1730, when export statistics first become available, and 1822, when Brazil attained independence, may be divided into three distinct periods. For lack of better terms, the first, lasting until 1755, may be called the first era of free trade. The second, extending from 1756 to 1777, was a period of monopoly, when the economy of the Amazon region was controlled by the famous Companhia do Grão Pará e Maranhão. That control ceased in 1778, when the company was unable to secure renewal of its charter and another era of free trade began.

It was also in 1778 that a curious governor directed the clerk of the Customs House in Belém to prepare a report based upon now missing ex-

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1724 (referring to the latter's dispatch of 6 Sept., 1724), AHU, cod. 285 (no folio).

[131] Overseas Council to Maia da Gama, 21 Feb., 1728 (citing a policy established in 1723), *ABAPP* 2 (Rpr. [Belém], 1968): pp. 217–218.

[132] Overseas Council to Alexandre de Sousa Freire, 11 Jan., 1730 (referring to the latter's dispatch of 5 Oct., 1729), *ibid.* 3: pp. 273–274.

[133] Barata (cited n. 94). p. 11. The earliest reference to a cacao plantation that I have seen is a dispatch of 1735 concerning the petition of Domingos da Costa Barcella, citizen of Belém, who described himself as "one of the principal settlers of the said outpost (*praça*)" and boasted that he had under cultivation more than 21,800 cacao trees, 1,200 coffee trees, and was producing various other crops and consequently was qualified to receive a habit in the Order of Christ and a pension from the crown. Overseas Council to governor of Maranhão, 3 Aug., 1735, AHU, cod. 270, f. 227r. Another rare example from the same decade is a land grant (*sesmaria*) issued to Gonsalo Soares Moniz by Governor João de Abreu de Castelbranco on 2 Nov., 1737 (AHU/PA/Pará, cx. 3) confirming his right to possess half a league of land containing 12,000 cacao trees which his father had occupied by squatting some years before.

[134] The above is based primarily on M[ano]el Ant.o Fon[sec]a to the king, 10 Sept., 1736 (orig.) and Overseas Council to king, 30 Jan., 1737 (orig.), AHU/PA/Pará, cx. 3 (copies of both are in *ibid.*, cx. 9).

[135] Overseas Council to governor of Maranhão, 24 April and 28 May, 1737, AHU, cod. 270, fols. 254r. and 281v.

[136] In 1731 the crown offered twelve-year exemptions from customs duties in order to stimulate production of other Amazonian "spices." Overseas Council to king, 27 June, 1731, AHU/PA/Maranhão, cx. 31 (orig.); *idem* to Alexandre de Sousa Freire, 30 July, 1731, AHU, cod. 270, f. 138r.; petition of Joseph de Carv[alh]o e Abreu and five others to king, Lisbon, 23 Aug., 1731, AHU/PA/Maranhão, cx. 19 (orig.). The fact that cacao producers were not offered such privileges at this time indicates that the crown was satisfied that the cacao industry required no additional official encouragement.

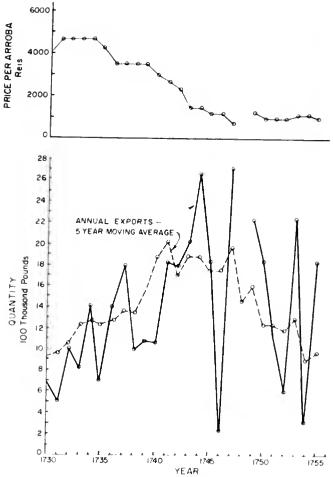

FIG. 1. Cacao exports from Belém, 1730–1755. Source: A (see appendix 2).

port registers in that office showing the prices and quantities of all exports from Belém for the years 1730–1755. Identified as source "A" in the graphs and tables that follow, this summary, which begins five years after the apparent start of continuous cacao exports, is the first vital segment in our statistical series which, with a few gaps, extends to 1822. The movements of quantities and prices during this initial period are presented in graphic form in figure 1 and in tabular form in appendix 1.

According to the Customs clerk's analysis, total cacao exports from Belém during the years 1730–1755 exceeded 35,000,000 pounds. The yearly averages appear to have been much larger than those reported for Venezuela during most of the seventeenth century,[137] though, as already mentioned, substantial quantities of Venezuelan cacao went unrecorded because of clandestine trade. The exceptionally high prices at Belém during

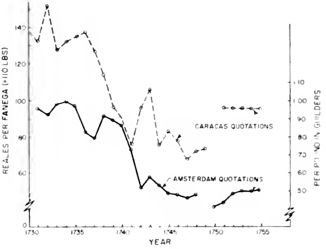

FIG. 2. Price movements of Caracas cacao, 1730–1755. Sources: Arcila Farias, *Comercio*, p. 135. Beginning in 1752, price fixed, initially at 96 reales per fanega. Posthumus, *Inquiry* 1: pp. 195–196.

the quinquennium 1730–1734 explain the previously described rush of canoes to the interior during these years; after 1734, however, prices began to decline and they continued to do so for the remainder of the period, following the downward price trends of the dominant Venezuelan product both in Caracas and in Amsterdam during these years (*cf.* figs. 1 and 2). As table 1 demonstrates, between 1730 and 1744 cacao represented 90.6 per cent of the total registered exports of Belém; between 1745 and 1753, however, that percentage plummeted to 61. The wide fluctuations in exports during this decade were related to a severe labor shortage caused by a smallpox epidemic which swept the lower Amazon during these years[138] and by a shortage of shipping which may have been related to the European maritime wars of the 1740's and to readjustments immediately after their conclusion.[139] During the same decade cacao prices,

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[137] See Arcila Farias, *Comercio*, pp. 71 f.

[138] Between 1743 and 1750 an estimated 40,000 persons perished because of smallpox which especially affected the indigenous population of the settled parts of the Lower Amazon and those living in upriver missions. The most extensive accounts of the plague are Francisco Pedro de Men[donç]a Gorjão (governor) to king, 26 Apr., 1749, and Mathias da Costa e Souza (treasurer) to king, 15 Nov., 1751, both in AHU/PA/Pará, maço 1.

[139] E.g., no ships reached Belém in 1748 and only one did so in 1752. See appendix 1 and source "A." In his covering dispatch enclosing the latter, the governor emphasized that the slump in exports during the early 1750's was directly related to the irregularity of shipping. João Pereira Caldas to Martinho de Melo e Castro (colonial secretary), 31 Aug., 1778, AHU/PA/Pará, cx. 38.

TABLE 1

CACAO AS A PERCENTAGE OF PARÁ'S TOTAL EXPORTS, 1730–1755 (in *réis*)

Year	Total exports	Cacao	Per cent cacao
1730	102,364,376	88,258,750	86.2
1731	90,513,908	78,236,250	86.0
1732	172,125,124	157,161,450	91.3
1733	135,811,630	125,684,850	92.5
1734	220,501,937	212,016,000	96.1
1735	115,936,024	93,601,987	80.7
1736	163,473,615	158,015,250	96.6
1737	111,194,355	100,528,687	90.3
1738	120,935,524	112,628,700	93.1
1739	135,863,249	123,153,862	90.6
1740	109,351,291	100,528,687	91.9
1741	169,991,290	161,634,462	95.0
1742	145,722,201	134,809,875	92.5
1743	109,956,228	94,948,968	86.3
1744	123,624,070	111,767,577	90.4
1745	94,872,809	68,555,392	72.2
1746	10,480,248	8,421,675	80.3
1747	118,108,921	76,769,353	64.9
1748	none		
1749	107,564,129	69,018,862	64.1
1750	109,774,241	69,837,968	63.6
1751	75,555,454	35,221,406	46.6
1752	33,693,157	19,649,313	58.3
1753	146,403,119	77,645,837	53.0
1754	17,708,976	11,336,221	64.0
1755	133,230,313	58,000,343	43.5

SOURCE: "A" See appendix 2.

which had been several times greater per unit than for prime quality Bahian white sugar, stabilized at a level slightly lower than that for the Bahian commodity (see fig. 3).[140]

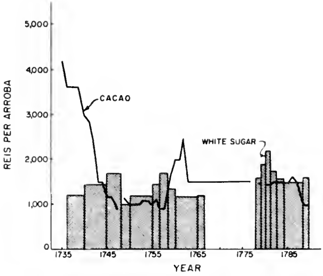

FIG. 3. Export prices of cacao (Belém) and white sugar (Bahia), 1735–1790. Source: see note 140.

In the 1730's when profit-taking must have been at its maximum,[141] even a royal judge invested in spice-collecting expeditions to the interior.[142] Although private speculators may have complained about that official's participation in the trade, the sort of competition they most deeply resented came from the colonists' traditional rivals, the missionaries. Conflicts between the settlers and the missionaries had existed since the beginnings of colonization in the Amazon and concerned such issues as the missionaries' opposition to the enslavement of the Amerindians, their segregation of Indians in remote mission compounds from which seculars were excluded, their efforts to supervise labor relations between the Indians and the settlers, and the special royal privileges they enjoyed, exempting them partially or entirely from payment of customs duties on goods they exported.[143]

To finance their various activities in the area, the missionaries produced some cacao on their plantations but utilized their mission neophytes to gather far more in the interior. As early as 1704, the municipal council (*câmara*) of Belém complained to the king about such competition and echoed an already old refrain expressed by câmaras in other parts of the Portuguese empire when it alleged that by engaging in the spice trade the missionaries were forsaking their spiritual obligations and, by depriving the settlers of the workers they needed, were therefore responsible for the continued impoverishment of His Majesty's subjects.[144]

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[140] Cacao prices in figure 3 are based upon appendix 1, while sugar prices for these years were taken from [Añon.], "Discurso preliminar, historico, introductivo, com natureza de descripção economica da comarca e cidade da Bahia . . ." (*ca.* 1789), *ABNRJ* 27 (1906): pp. 283–348, at 306. The series for sugar may be extended back to 1677–1710. See Antonil, *Cultura e opulencia* (cited in n. 121), pp. 29, 270.

[141] Concerning the problem of calculating profits in the Amazonian cacao industry, see appendix 3.

[142] Francisco Duarte dos Santos to king, 12 [no month] 1734. AHU/PA/Pará, cx. 8 (orig.), reporting that former magistrate Luis Barboza de Lima had followed the practice of his predecessors by outfitting a canoe for the spice trade.

[143] The nature of such conflicts is examined in some detail in D. Alden, "Economic Aspects of the Expulsion of the Jesuits from Brazil: A Preliminary Report," in: Henry H. Keith and S. F. Edwards, eds., *Conflict and Continuity in Brazilian History* (Columbia, S. C., 1969), pp. 25–65, and *idem*, "Black Robes versus White Settlers: the Struggle for 'Freedom of the Indians' in Colonial Brazil," in: Howard Peckham and Charles Gibson, eds., *Attitudes of Colonial Powers Toward the American Indian* (Salt Lake City, 1969), pp. 19–45.

Though the câmara repeated such charges in subsequent years,[145] it was unable to provoke a positive response from the crown until the late 1720's when it engaged the services of a long-time resident and Jesuitophobe, Paulo da Silva Nunes, as its lobbyist at court.[146] In 1728, after receiving one of Silva Nunes's early memorials condemning the economic role of the missionaries, the crown called upon officials of the Society of Jesus to disclose the extent of their order's involvement in the Amazon spice trade. The Jesuits responded with a detailed report that listed the amount of cacao (by far the most important), cloves, and sarsparilla credited to each of their thirteen missions in the region and to their college in Belém for the year 1728. Significantly, out of a total of 94,018 pounds of cacao they admitted exporting that year, only 2,042 came from orchards; the remainder came from feral sources.[147]

But the missionaries' rivals soon produced two quite different estimates of their own. Both were evidently prepared by or for Paulo da Silva Nunes, the first *ca.* 1730, the other dated 1734. Except for the fact that the second claimed to have been based upon import registers in the Casa da Índia in Lisbon, neither is documented, yet both offered rather precise (but almost invariably rounded) estimates of the yield of each missionary property and mission in the Amazon. The first placed the missionaries' total annual cacao harvest at 297,600 pounds, all but 700 pounds from feral sources, while the second raised the total estimate to 427,200 pounds.[148]

These estimates were submitted as part of an intensified settler campaign against the missionaries during the 1730's. It was also in 1734 that the municipal councils of Belém and São Luiz do Maranhão framed separate petitions to the king renewing old pleas that the missionaries' authority over the Indians be restricted to spiritual matters. They again charged that the padres were depriving them of Indian laborers and were employing them to extract from the backlands "more spices . . . than all the seculars combined." In response the heads of each order in Belém signed a statement attributing the unfounded contentions of the settlers to their own greed for "the few grains of cacao" that the orders were exporting and "upon which depends the conversion and growth of the missions." [149]

The same year the crown, exasperated by such conflicting testimony, dispatched a special investigator to the Amazon to ascertain the veracity of these charges and countercharges. That investigator, *Desembargador* Francisco Duarte dos Santos, a member of the High Court of Oporto, consulted representatives of each interest group and examined pertinent documents. He concluded that there was little merit to most of the settlers' allegations. With respect to their contention that the missionaries were extracting 85 per cent of the cacao bravo taken from the Amazonian interior, he found that the records kept at the Gurupá fortress told a different story. Of the 721,056 pounds registered there that year, only 273,056 or 37.8 per cent belonged to the religious and from that amount one-fifth was owed to the boat masters. He branded as mere "fantasies" the detailed reports of 1730 and 1734 submitted by Paulo da Silva Nunes, but he concluded that "the principal cause and motive of the public complaints against the missionaries . . . derives from the fact that there are not half enough Tapuias [Indians] in the *aldêas* [missions] to equip the great number of canoes that

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[144] Câmara to king, 17 July, 1704, and *idem* to *idem*, 13 Mar., 1705, AHU/PA/Pará, cx. 3. Appended to the first protest is a fascinating list of the commercial transactions of a local merchant with the various religious orders. Although the sums involved were small, the câmara professed to be scandalized by their magnitude.

[145] E.g., câmara to king, 12 Jan., 1710 AHU/PA/Pará, cx. 3, protesting against the "absolute dominion and jurisdiction" of the missionaries on the island of Marajó (opposite Belém) where the padres were charged with utilizing 3,000 Indians to gather "cloves, cacao, and other valuable commodities (*utilidades*)."

[146] For a sketch of his activities, see Alden, "Economic Aspects," pp. 34–40.

[147] The report, completed in Belém on 21 Sept., 1728 by Padre Joseph de Mendonça (vice provincial of the Society), was submitted by its procurator general, Raphael Mendes, in Lisbon on 10 July, 1729. There is a copy in BPE, cod. CXV/2-12, fols. 263r.–265r.

[148] The first (and undated and untitled) estimate is in AHU/PA/Pará, cx. 3. A defective text of the second, "Calculo do importantissimo cabedal que embolçarão os Revms. Missionarias . . . nas aldêas . . . cidades, villas, e fazendas que tinhão no estado do Maranhão," n.d. but from internal evidence drafted in 1734, is published in A. J. Mello Moraes, comp., *Archivo do Districto Federal; revista de documentos para a história da cidade do Rio de Janeiro* 2 (Rio de Janeiro, 1895): pp. 472–484. Both were intended to demonstrate how much the Royal Treasury lost each year because of the missionaries' refusal to pay the tithe and other assessments.

[149] Overseas Council to Junta de Missões do [Estado do] Maranhão, 13 Apr., 1734, and Junta to king, Belém, 21 Aug., 1734, BNL/FG, cod. 4517, fols. 252r.–v.

TABLE 2

EXPORTS BY THE RELIGIOUS ORDERS FROM BELÉM TO LISBON, 1743–1745
(in pounds)

Order	Cacao	Cloves	Coffee	Sarsparilla	Sugar
Jesuits	341,306	54,905	1,817	11,172	10,130
Carmelites	83,808	100	374	320	4,673
Mercedarians	8,384	832	—	128	—
Franciscans	56	28	20	—	—
Totals	433,554	55,865	2,211	11,620	14,803

SOURCE: See note 155.

they [the settlers] dispatch to collect cacao. . . .”[150]

Although the Overseas Council accepted the findings of the Santos report,[151] the role of the missionaries in the spice trade continued to arouse complaints. Thus, about 1743 the tithe contractor in the captaincy of Pará explained his inability to fulfill the terms of his contract because of the “excessive number of arrobas of commodities” that the Jesuits were exporting without paying the tithe. Such shipments, he claimed, amounted to over 144,000 pounds of cacao, sarsparilla, cloves, and coffee that year.[152] The contractor’s complaint was supported by the câmara of Belém which, in December, 1744, likewise justified its failure to meet its current fiscal responsibilities on the ground that the religious orders were continuing to export large quantities of spices “a majority of which pay no taxes to Your Majesty.” That year alone, the council declared, the religious had exported to the kingdom in excess of 800,000 pounds of cacao, cloves, and sarsparilla.[153]

In due course—nearly two and a half years later!—the Overseas Council instructed the royal treasurer in Pará to investigate these new assertions.[154] That official responded that it was not easy to determine precisely what proportion of the spices shipped by the religious originated in the backlands, since they also produced some on their estates near Belém and obtained others in exchange for provisions they sold and in the form of alms. But he concluded that the magnitude of the spice shipments of the religious had never been as great as the câmara imagined and in support of his conviction included a report from the Customs clerk of Belém listing all commodities sent by the religious in the fleets of 1743, 1744, and 1745.[155] That unique report is summarized in table 2. Strangely, the clerk did not record the total exports of Belém for these years; had he done so, a simple comparison of the two sets of figures should have been sufficient to demonstrate that the missionaries’ share of the cacao trade amounted to a modest 6.6 percent![156] But although this report indicated once again that the missionaries were far from being engrossers of cacao, it was simply filed away without comment while complaints against the missionaries’ economic activities persisted.

In 1751 such charges found an especially sympathetic ear when the new royal governor, Francisco Xavier de Mendonça Furtado, reached Belém. Brother of the formidable future Marquis of Pombal, dominant minister of Portugal from 1750 until 1777, Mendonça Furtado shared Pombal’s acute sense of regalism and his contempt and antipathy toward religious orders in general and the Jesuits in particular. Less than two months after arriving at his post, the governor wrote a lengthy report in which he condemned the religious for their monopoly of the lucrative Amazon spice trade. Although he cited no new

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[150] Francisco Duarte dos Santos to “Rno. Sr.” [Cardinal da Mota], 10 Sept., 1734, AHU/PA/Pará, maço 1; *idem* to king, 15 July, 1735, Alexandre João Mello Moraes, comp., *Corographia . . . do império do Brasil* (Rio de Janeiro, 1860), pp. 123–150, at 138.

[151] Consulta of 5 Oct., 1736, BPE, cod. CXV/2-15, fols. 21r.–28r.

[152] Petition of Joam Francisco to king, *ca.* 1743, AHU/PA/Pará, cx. 12.

[153] Câmara to king, 5 Dec., 1744, *ibid.*, cx. 14.

[154] Overseas Council to provedor da fazenda (Pará), 11 Mar., 1747, *loc. cit.*

[155] Lour[en]co d’Anv.ce Pacheco to king. 20 Oct., 1747, enclosing report of Pedro Cavalleyro e Cavalleyro, *escrivão proprietario*, alfandega de Pará, 18 Sept. 1747, *loc. cit.*

[156] *Cf.* the totals recorded for these years in table 2 and appendix 1.

TABLE 3

CACAO SENT TO BELÉM BY SECULARIZED INDIAN COMMUNITIES IN THE AMAZON DURING SELECTED YEARS

Year	Amt. in lbs.
1761	209,648
1764	222,985
1768	386,834
1769	215,047
1770	101,363
1771	109,801
1772	517,267

SOURCES: "Mapa[s] gera[is] do rendimento que ouve na thezouraria do commercio dos Indios . . ." for the indicated years, AHU/PA/Pará, cxs. 21, 26, 29, 30, 32, and 33.

evidence—indeed, he provided none whatsoever—he contended that their economic activities were seriously damaging the state itself and were reducing His Majesty's subjects to "the last stages of poverty and misery." [157] This was the opening salvo in a merciless, uncompromising campaign that Mendonça Furtado and his zealous collaborator, Dom Miguel Bulhões de Sousa, bishop of Pará, waged against the missionaries, particularly the Jesuits, with the enthusiastic support of Pombal.[158] In 1757 they achieved one long-standing settler goal when the king secularized the administration of the Brazilian missions, but they won their greatest victory in 1759/1760, when the Jesuits were expelled from Portugal and her empire.[159]

Without doubt Mendonça Furtado was keenly concerned about the economic development of the Amazon area and especially the continued growth of its most important export staple. Recognizing the superiority of cacao manso over cacao bravo, the governor repeatedly tried to encourage the expansion of plantation cacao, though without conspicuous success.[160] He hoped that under the prodding of quasi-military directors, the former mission neophytes would become sturdy farmers. Although the Indians remained notoriously reluctant to cultivate crops that they could easily obtain in the forest,[161] the former mission settlements did contribute significantly to the total stock of cacao, as table 3 demonstrates. The governor also played a vital role in the crown's decision to solve two of the cacao industry's long-standing problems, namely shortages of labor and shipping, by the establishment of a royal monopoly trading company.[162]

The Companhia do Grão Pará e Maranhão was one of a half-dozen similar joint stock companies created by the Pombaline regime to promote regional economic development and to lessen Portugal's dependence upon "alien" (British and Jesuit) capital.[163] Its twenty-year charter, issued in 1755, required the company to furnish northern Brazil with regular armed fleets and to supply it with adequate quantities of African slaves and European merchandise at reasonable prices. Although obliged to send their goods in company vessels, colonial shippers initially possessed the option of selling them to company agents or of continuing to consign them to their Lisbon correspondents.[164] But the company's early experience with cacao soon led to the elimination of that option.

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[157] [Mendonça Furtado] to [Sebastião José de Carvalho e Melo], 21 Nov., 1751, *A Amazônia na era pombalina: Correspondencia inédita do governador e capitão-general do estado do Grão Pará e Maranhão Francisco Xavier de Mendonça Furtado, 1751–1759*, ed. Marcos Carneiro de Mendonça (3 v., Rio de Janeiro, n.d. [*ca.* 1964]) (hereafter cited as *C/FXMF*) **1**: pp. 63–78, at 78.

[158] Other major reports of the governor critical of the Jesuits' economic activities and especially their involvement in the cacao trade are published in *ibid.* **2**: pp. 485–489, and **3**: pp. 955–976. In another study I intend to examine the key roles played by the governor and the bishop in providing the future marquis of Pombal with the "evidence" necessary to justify the expulsion of the Jesuits.

[159] See Alden, "Economic Aspects" (cited in n. 143), pp. 40–54.

[160] A significant omission in the comprehensive economic report prepared by the veteran magistrate João Antonio da Cruz Diniz Pinheiro in 1751 is any mention of cacao plantations, although the author refers to sugar estates, brandy distilleries, and livestock ranches. See Azevedo, *Os Jesuítas* (cited in n. 90), pp. 343–347. For Mendonça Furtado's interest in cacao production, see especially his dispatch to Diogo Mendonça Corte Real (colonial secretary), 22 Jan., 1752, *C/FXMF* **1**: pp. 202; *idem*, proclamation of 3 Oct., 1753, *ABAPP* **3**: p. 171. and *idem*, "Memoria das fazendas . . . ," 8 Feb., 1754, *C/FXMF* **2**: pp. 485–489. There are a few references to cultivated cacao orchards in Queiroz, *Visitas pastorais* (cited in n. 113 above). See pp. 169 and 391.

[161] See Sampaio, "Appendice" (cited in n. 115 above), pp. 73–83, and table 7 (facing p. 118).

[162] Mendonça Furtado to Diogo Mendonca Corte Real, 18 Jan. and 1 Feb., 1754, *ABAPP* **3**: pp. 207–209, and 203–205.

[163] According to chap. 48 of its statutes (see n. 164), the company was to be capitalized at 1,200,000 *cruzados* (approximately £130,000). Colonials and foreigners were invited to take up shares, but in practice 90 per cent of the capital was subscribed by Peninsulars, including high government officials, nobles, members of religious orders (especially nunneries), and merchants. Manuel Nunes Dias, "Fomento ultramarino e mercantilismo: a companhia geral do Grão-Pará e Maranhão (1755–1778)", *RHSP* **68** (1966): p. 404.

During the first years of the monopoly most Belém exporters preferred to ship on their own account rather than sell to the firm. Such preference is reflected in the low percentages of company-owned cargoes its vessels carried to the Peninsula—9.7 per cent by value in 1756, 10.3 per cent in 1757, and 19.1 per cent in 1758. Until 1759 the company offered between 960 and 1,200 réis per arroba for cacao, approximately the prevailing market price during the preceding decade. Then, in 1759, the local agent yielded to pressures brought by exporters and supported by Mendonça Furtado's successor and raised the price to 1,500 réis.[165] The same year the ratios between company- and privately-owned cacaos in the Lisbon-bound fleet were reversed—77.7 per cent belonged to the company. The following year, acting in all probability as a result of a company complaint, the crown eliminated the previously mentioned option and designated the company as exclusive agent for all shipments from the Amazon; as a result, between 1759 and 1777, 85.8 per cent of the Lisbon-bound cargoes it hauled belonged to the company.[166] But, although it temporarily raised its asking price for cacao to 2,000 réis per arroba in 1760, matching a similar rise in prices offered for Caracas cacao, the company reduced its price to 1,500 in 1764 and that remained the official price for the rest of the monopoly period. Since a comparable fall in prices for the dominant Caracas product did not occur at this time (*cf.* figs. 4 and 5), the Grão Pará Company may well have been improving its profit margin in the 1760's.[167]

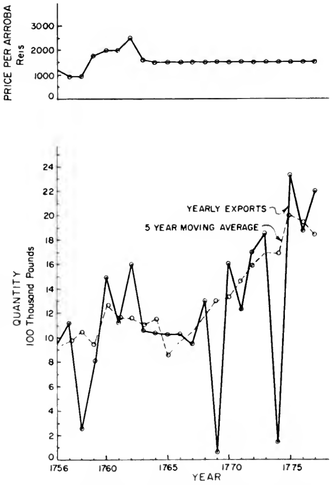

FIG. 4. Cacao exports from Belém, 1756–1777. Source: Nunes Dias, "Cacao" (see n. 94), facing p. 368.

Manuel Nunes Dias, the Grão Pará Company's most indefatigable historian and an ardent admirer of both the company and the Marquis of Pombal, credits the company with having greatly accelerated the production of cacao between 1755 and 1777.[168] The principal thesis that runs throughout his lengthy history of the company is that prior to its formation, the economy of the Amazon was entirely one of subsistance and that it was the company that first linked the Amazon's productive centers to European markets.[169] Un-

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[164] Among other places, the company's statutes of 6 June, 1755, are published in *Collecção chronológico de leis extravagantes posteriores á nova compilação das ordenações do reino* . . . **3**: (Coimbra, 1819): pp. 437–465. It is no coincidence that they bore the same date as a royal decree which definitively abolished Indian slavery in the Amazon. Alvará of 6 June, 1755, *ibid.*, 421–434.

[165] Manoel Bernardo de Mello de Castro (governor of Pará) to Mendonça Furtado (colonial secretary), 9 Aug., 1769, *ABAPP* **11** (rpr., Belém, 1969): pp. 321–322.

[166] Nunes Dias, "Cacao" (cited in n. 94), pp. 364–366; percentages computed from table on p. 365.

[167] In his dispatch cited in n. 165 above, Governor Mello de Castro charged that the company was reaping exceptional profits from its cacao operations. He observed that while it purchased cacao in Belém at 2,000 réis per arroba and incurred additional (largely transit) expenses of 1,000 réis per arroba, it sold cacao in the Lisbon auctions for 5,200 to 5,400 réis per arroba. It has not been possible to check the accuracy of the governor's statement. The "Mappa geral dos generos da produccao' do Pará e Mar[anhão] que a companhia geral daquelles estados tem arrematado em leiloes desde . . . 1758 athe agosto de 1777" (AHU/PA/Pará, cx. 37) indicates quantities but unfortunately not prices.

[168] Nunes Dias, "Cacao," especially pp. 364 and 376.

[169] Nunes Dias's dissertation (see n. 163 above for its title) has been published serially in *RHSP* **66–84** (1966–1970) and recently in book form. Its thesis is particularly evident in *RHSP* **67**: pp. 364–365.

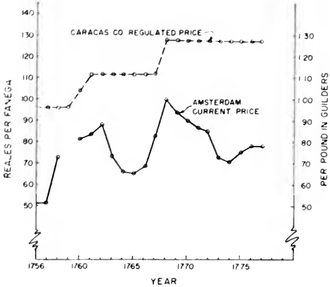

FIG. 5. Price movements of Caracas cacao, 1756–1777. Sources: Arcila Farias, *Comercio,* p. 135; Posthumus, *Inquiry* 1: p. 196.

less one is prepared to disprove the statistical evidence cited in the preceding pages (something Nunes Dias has *not* done) or simply ignores such evidence (as Nunes Dias apparently did), such a thesis is untenable.[170]

A comparison of the available data for the years 1730–1755 and 1756–1777 clearly suggests that the company historian's claims are inflated. Between 1730 and 1755 total cacao exports amounted to 35,059,682 pounds, or about 1,348,450 a year.[171] Total shipments between 1756 and 1777 were 27,962,123 pounds, or 1,331,434 pounds per year (see appendix 1). Although the yearly export averages were thus fractionally lower during the company period, the trend revealed by the five-year moving averages is unmistakably upward, in contrast with the downward slope of the late 1740's and the early 1750's. That shift may be partly explained by the company's ability to provide somewhat more dependable shipping service,[172] and also by an increase in the available labor supply, namely imported African slaves, some of whom presumably contributed to an increase in plantation-grown cacao.[173] But, as is evident from table 4, in spite of substantial fluctuations, cacao shipments continued to average 61 per cent by value of total exports during the monopoly period, exactly their percentage during the decade 1745–1755. It

TABLE 4

CACAO AS A PERCENTAGE OF PARÁ'S TOTAL EXPORTS, 1756–1777

(in *réis*)

Year	Total exports	Cacao	Per cent cacao
1756	88,767,238	35,701,087	40
1757	71,483,583	33,834,870	47
1758	15,114,867	7,642,110	50
1759	90,228,551	54,254,928	60
1760	140,200,288	93,846,062	66
1761	130,952,764	72,118,000	55
1762	147,907,589	121,710,187	82
1763	77,475,613	58,563,930	75
1764	91,887,662	49,023,234	52
1765	93,007,029	47,417,109	52
1766	90,704,472	47,917,218	53
1767	89,195,787	43,811,243	48
1768	90,706,716	61,461,140	66
1769	4,072,508	1,505,625	35
1770	114,669,083	76,873,921	67
1771	103,526,773	57,814,921	55
1772	120,798,861	81,543,421	67
1773	121,172,452	88,177,218	72
1774	15,929,555	6,168,152	38
1775	168,365,504	109,362,000	65
1776	156,244,335	87,610,734	56
1777	170,508,251	103,510,499	60
Totals	2,192,979,481	1,339,867,609	
Mean			61

SOURCE: Dias, "Cacao" (see n. 94), p. 373.

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[170] At one point the author mistakenly stated that the first data available from customs' records dates from the Mendonça Furtado years. *Ibid.*. p. 83. It is evident that he overlooked source "A" and other statistical reports cited in earlier pages of this study.

[171] Omitting 1748 when no shipments were made.

[172] An average of 6.7 ships per year left Belém for Lisbon during the years 1756–1777, but the number of clearances in 1758, 1769, and 1774 was only 2, 2, and 4 respectively, thus explaining the troughs in figure 3 coinciding with these years. See Nunes Dias, "Cacao," p. 376.

[173] Between 1757 and 1777 the company introduced 14,749 slaves into Pará from its stations at Guinea and Angola. "Recapitulação dos dois mappas dos escravos intruduzidos pela companhia geral de Grão Pará e Maranhão nos ditos estados desde . . . 1757 até 1777," AHU/PA/Pará. cx. 37. The ultimate destinations of these chattel are unknown, though many appear to have been used as household servants rather than as field hands. Colin M. MacLachlan, "African Slavery and Forced Development [in the Amazon]" (unpublished paper, 1971). It is clear from episcopal visitations made in the decade after the Company's charter lapsed that the future cacao corridor of plantations between the cities of Santarém and Óbidos was beginning to take shape. See Dom Caetano Brandão, *Memorias para a historia da vida do veneravel arcebispo de Braga* (2d ed., Braga, 1867) 1: pp. 158–159, 176, 182, 249, 290, 291, 318, and 335 for mentions of cacao plantations in this zone.

TABLE 5

Pará Cacao Shipments as a Percentage of Total Cacao Exports from Brazil, 1776–1822
(in pounds)

Year	Maranhão	Bahia	Rio de Janeiro	Pará	Totals	Per cent Pará
1776	4,368	1,056		1,869,029	1,874,453	99
1777	896			2,208,224	2,209,120	99
1779	7,862			1,852,304		
1780	6,405			1,932,667		
1781	13,175			1,295,705		
1796	7,808	4,096		1,539,712	1,551,616	99
1797	1,312	640		2,377,088	2,379,040	99
1798	15,680			3,019,752	3,035,432	99
1799	6,976	1,152		2,697,664	2,705,792	99
1800	25,088	118,464	864,000	4,069,792	5,077,344	80
1801		47,488	78,528	2,063,200	2,189,216	94
1802	9,952			4,437,408	4,447,360	99
1804		10,336		3,448,080	3,458,416	99
1805		467,296		3,171,024	3,638,320	87
1806	11,568	5,056	101,792	6,786,400	6,904,816	98
1807	8,224[a]	343,520		4,639,168	4,990,912	92
1809		26,928[b]	44,432	6,566,944	6,638,304	98
1813			60,160	2,737,056	2,797,216	97
1816				4,090,464	4,090,464	100
1821				2,997,664	2,997,664	100
1822				4,359,104	4,359,104	100

[a] "cafe, cacao, Tapiac, etc."
[b] Attributed to Pernambuco but probably from Bahia.
Sources: Appendix 2, B, C, D-9 to D-11, and E-1 to E-18.

therefore seems apparent that while the declining volume of cacao exports during the late 1740's and the early 1750's was reversed during the monopoly period, the company did not significantly contribute to the real growth of the Amazonian cacao industry.

TABLE 6

Cacao as a Percentage of Pará's Total Exports, 1776–1822
(in *réis*)

Year	Total exports	Cacao	Per cent cacao
1776	156,231,475	87,473,250	55
1777	131,061,955	87,771,100	66
1796	330,464,055	100,563,485	30
1797	255,506,350	155,996,400	61
1798	381,320,280	207,607,400	54
1799	565,109,863	269,766,400	47
1800	598,504,930	305,234,400	50
1801	279,056,983	122,502,500	43
1802	417,127,689	167,519,637	40
1804	478,378,124	188,573,875	39
1805	623,312,420	299,213,550	48
1806	752,708,741	508,980,000	67
1822	560,499,070	310,586,160	55
Mean			50.39

Sources: Appendix 2, E-1 to E-12 and E-18.

In 1775 the Grão Pará Company's charter expired but was extended for two additional years. A special royal commission then considered proposals to renew the charter for one or more decades, but, by the margin of a single vote, it decided to terminate the company.[174] Thus began

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[174] Undated memorandum concerning the deliberations of the *ad hoc* council's meeting of 15 July, 1777, AHU/PA/Pará, cx. 37. The charter of the sister Pernambucan monopoly company was also permitted to expire. Manuel Nunes Dias interprets the opposition to both companies as motivated by personal animus against Pombal by high officials who succeeded the marquis after his dismissal from office in 1777. See "A Junta liquidatária dos fundos das Companhias do Grão Pará e Maranhão, Pernambuco e Paraíba (1778–1837)," *Revista portuguesa de historia* **10** (Coimbra, 1962): pp. 156–161. But such a thesis ignores the free trade views of merchants on both sides of the water. See "Representarao q. se fas p[ara] nao dever prezentes por mais tempo a comp[anhia] geral do estado do Gram Para e Maranhao . . . pellas vassalos interessantes de comercio franco e geral desta prasa [Belém] e dos

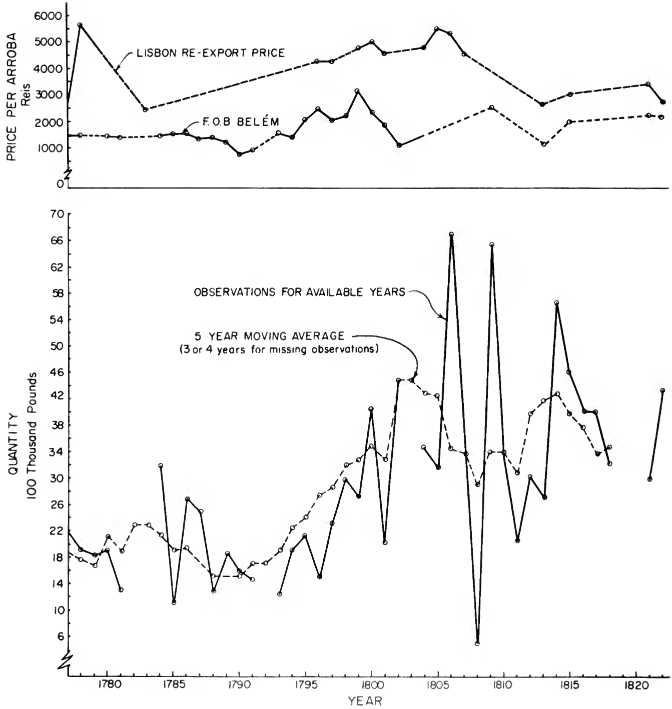

FIG. 6. Cacao exports from Belém, 1777–1822. Sources: see tables 6 and 7.

the third and last period of the Amazonian cacao industry during the colonial era.

Statistical information related to the Amazonian cacao industry is more diverse and more abundant for the years 1778–1822 than it is for the two earlier periods. As is apparent from table 5, although cacao cultivation spread to other parts of Brazil during the eighteenth century, the Amazon continued to be the primary export center.[175] Still, consistent with the behavior of once domi-

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mesmos habitantes do ditto estado," an undated memorandum addressed to the queen in AHU/PA/Pará. cx. 15, where the pencilled date of 1752 is clearly incorrect. Internal evidence makes it clear that this eighteen-page petition, signed by forty-seven planters and merchants, was drafted in 1777.

[175] The surprisingly large exports credited to Rio de Janeiro for the year 1800 may represent reshipments from other producing centers, especially Bahia, or they may simply be a scribal error.

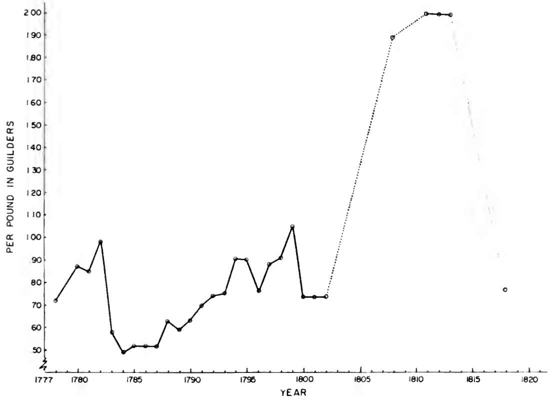

FIG. 7. Price movements of Caracas cacao, 1777–1822 (Amsterdam current prices). Source: Posthumus, *Inquiry* 1: pp. 196–197.

nant staples elsewhere, cacao's share of that region's total exports gradually diminished until it represented barely half of the value of all exports from the Amazon (see table 6).

With exception of four brief intervals for which data are unavailable, the flow of cacao exports from Belém to Lisbon during this period is indicated by figure 6. It is evident from this graph and from appendix 1 that the level of exports remained fairly stable throughout the late 1770's and the decade of the 1780's, when cacao prices were generally low.[176] With the onset of maritime warfare in the 1790's, prices advanced rapidly (see fig. 7);[177] surprisingly, however, the yearly volume of exports from the Amazon did not increase markedly during that decade, presumably because of insufficient shipping. The swelling of Amazonian exports during the first and second decades of the nineteenth century was almost certainly related to the previously mentioned diminution of Venezuelan exports during these decades. The annual average of 4,319,981 pounds for the years 1800–1809 was more than double the level of exports during the two preceding decades. Although the French occupation of Portugal (1807–1809) temporarily disrupted the flow of cacao shipments to Lisbon, they resumed in 1809 and continued at a yearly average of 3,673,500 pounds for the next decade (see appendix 1 and table 6). During the late 'teens, however, when European prices dropped from abnormally high levels,[178] the gap between the Belém and the Lisbon price narrowed so much as to suggest that it was much less attractive for Portuguese buyers to purchase Brazilian cacao on the eve of the colony's independence than it

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[176] Amsterdam quotations for Caracas cacao dropped from a near high for the century of 1.00 guilder/lb. (1768) to a low of .49 in 1784, and did not rise above .59 for the remainder of the 1780's. Posthumus, *Inquiry* 1 (cited n. 81 above): table 83. The yearly average of cacao exports from Pará did increase from 1,681,307 lbs. (1770–1779) to 1,985,527 (1780–1789). Computed from appendix 1.

[177] The Belém price climbed from 1,000 réis/arroba (1789) to 3,200 (1799), far exceeding the rise in Amsterdam prices which advanced from .59 guilder/lb. (1789) to 1.05 (1799). *Cf.* Posthumus, *Inquiry* 1: table 83 and figure 5 above.

[178] The Amsterdam price reached an all time high of 2.08 guilders/lb. in 1813 but dropped to .78 by 1818. Posthumus, *Inquiry* 1: table 83. For unexplained reasons, Belém and Lisbon prices failed to follow the same trend.

TABLE 7

RE-EXPORTS OF BRAZILIAN CACAO FROM PORTUGAL, 1776–1822

(in pounds)

Year	Price[a]	Great Britain	France	Holland	Germanies[b]	Russia	Spain	Italy[c]	Other	Total
1776	2,700	23,312[d]	112,768	4,032				1,148,464		1,288,576
1777	5,700		100,864		7,424		1,150	1,511,776		1,621,214
1783	2,520	87,200	110,384	48,752	12,512		40,160	1,418,088	14,432[e]	1,731,528
1789	n.a.	800	67,936	139,712	320		152	544,096	3,456[f]	756,472
1796	4,300 to 4,360	9,632		17,280	56,368		11,488	1,154,752	10,224[g]	1,259,744
1797	4,360	576		175,584	361,792		8,880	168,352	3,680[h]	718,864
1799	4,800			19,104	281,744		1,241,424	686,400		2,240,896
1800	5,000	1,376	11,264	14,016	906,880	2,176	106,048	1,414,960	179,552[i]	2,636,272
1801	4,600	1,120	83,226		637,114		699,632	1,053,408		2,474,500
1804	4,840		482,016	179,408	81,296	10,144	365,356	1,110,736	20,320[i]	2,249,275
1805	5,500		942,816	166,720	371,776	6,016	428,080	1,070,864	26,080	3,012,352
1806	5,400	27,840	873,472	116,576	34,416	9,120	769,408	2,892,348	48,448	4,771,664
1807	4,600	41,376	431,296	150,360	39,536	33,920	568,928	777,248		2,042,664
1813	2,200	444,384		16,768		45,216				506,368
1816	3,050	68,480	482,544	566,080	188,032		397,152	1,152,128		2,854,416
1821	3,435	77,632	180,000	22,496		92,096	29,760	967,648	208,320[i]	1,577,952
1822	2,895		569,120	597,856	306,784		79,472	1,160,800	375,712[j]	3,089,744

SOURCES: Appendix 2, F-1, E-2, F-2 to F-12, E-15 to E-18.

[a] Réis per arroba.

[b] Ports of destination are sometimes indicated in the Balances which occasionally distinguish between Hamburg and "Prussia."

[c] The early Balances have separate entries for shipments to Venice, Genoa, and sometimes Naples. Later Balances simply indicate "Italy" as a destination and those for 1821 and 1822 designate Austria as the destination for shipments to Venice.

[d] Occasionally the Balances list separately shipments of chocolate. See table 9.

[e] A shipment to Sweden.

[f] A shipment to U. S. A.

[g] A shipment to Malta.

[h] Shipments to Denmark.

[i] Shipments to Barbary Coast.

[j] Shipments to Austria and other Habsburg territory, principally Venice.

had been during the peak years following the turn of the century.[179]

Most studies of New World cacao tend to ignore the question of what became of the American product when it arrived at its initial European port of entry. The role of Lisbon as a redistribution center for Brazilian cacao during the years 1776-1822 is suggested by tables 7, 8, and 9. Although stocks received in Lisbon during a given year were not necessarily sent abroad that same year, the data assembled for paired years in table 8 suggest that from one-half to two-thirds of the Amazonian product was regularly re-exported. Such a percentage was much greater than was the case with Spanish receipts of Venezuelan cacao, most of which was consumed within the kingdom itself.[180] Moreover, the re-export balances indicate that very little Brazilian cacao was re-exported in a processed form,[181] reflecting the rudimentary technological development of Portugal at this time (see table 9). As is apparent from table 7, during this period Italian markets

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[179] Writing a few years later, the British consul at Guayaquil observed that "The shipments of cocoa to Europe . . . for two years past have afforded little or no profit to the shipper as the exchange has been so much against the remitter that large investments have been made solely with a view of returning the proceeds . . . [in] merchandize. . ." Henry Wood to George Canning, 28 Feb., 1826, Humphreys, *British Consular Reports* (cited in n. 33 above), p. 230.

[180] By contrast, according to Humboldt (*Personal Narrative* **2**: p. 61), all but 15 per cent of the cacao sent from Caracas to Spain was consumed within the mother country, the remainder being exported to France, Italy, and the Germanies.

[181] Chocolate was manufactured in Lisbon and Oporto by the early 1820's but apparently on a small scale. Adrien Balbi, *Essai statistique sur le royaume de Portugal et d'Algarve* . . . (2 v., Paris, 1822) **1**: p. 448.

TABLE 8

Cacao Re-exports from Lisbon as a Percentage of Total Cacao Imports
(in pounds)

Year	Imports	Re-exports	Per cent of re-exports/ imports
1776	1,874,453	1,288,576	68.7
1777	2,209,120	1,621,214	73.3
1796	1,551,616	1,259,744	81.1
1797	2,379,040	718,864	30.2
1799	2,705,792	2,240,896	82.8
1800	5,077,344	2,636,272	51.9
1801	2,189,216	2,474,500	113.0
1804	3,458,416	2,249,275	65.0
1805	3,638,320	3,012,352	82.7
1806	6,904,816	4,771,664	69.1
1807	4,990,912	2,042,664	40.9
1813	2,797,216	506,368	18.1
1816	4,090,464	2,854,416	69.7
1821	2,997,664	1,577,952	52.6
1822	4,359,104	3,089,744	70.8
Mean			63.1

Sources: Appendix 2, E-1 to E-4, E-6 to E-8, E-10 to E-13, E-15 to E-18; F-1, F-4 to F-12.

(Genoa, Venice, and sometimes Naples) were the leading customers for Brazilian cacao, followed by Spain, France, and the Germanies.

Table 10 compares Amazonian cacao exports in successive decades. As is evident, although Brazil was usually a third-ranking and sometimes a second-ranking exporter, it never attained the position of dominant supplier. Normally a marginal supplier of a low-quality product, it gained its largest share of the European market during the first decades of the nineteenth century when maritime warfare drastically reduced the volume of shipments from the two major producers.

The manuscript sources which have provided the major statistical foundation for this study terminate in 1822 when Brazil became independent of Portugal. Cacao continued to be a prime export from the Amazon for another two generations.[182] Long before midcentury the ancient tropas de cacao had disappeared and extensive, narrow plantation zones decorated the littoral of the lower and middle reaches of the great river. But in spite of sometimes enthusiastic reports by nineteenth-century travelers, the general impression their accounts convey is that of modest, unprosperous plantations whose owners were handicapped by persisting shortages of labor (an endemic problem in the Amazon), lack of sufficient capital, burdensome creditor-debtor ties, and backward technology.[183] Unlike their competitors in Venezuela, Colombia, Guatemala, and in some of the islands of the Caribbean, Amazonian cacao planters failed to discover a more promising plantation crop, such as coffee, to replace cacao whose Brazilian center of production shifted in the late nineteenth century to southern Bahia.[184] By then the Amazon was in the midst of its second boom—natural rubber, whose methods of extraction and whose economic organization had been prefigured by local experience with cacao. Once again, another feral crop was simply "harvested" in the rainforest while plantation cultivation of *Hevea brasiliensis* was neglected until it was too late. In 1914, two years after the collapse of the rubber industry, Manuel Barata, descendent of a one-time cacao merchant and himself a pioneer regional economic historian, became a voice in the wilderness when he urged his people to abandon the "fetishism" of collecting rubber and to return to the agricultural sources of the Amazon's original prosperity.[185]

TABLE 9

Exports of Chocolate from Portugal
(in pounds and *réis*)

Year	Destination	Quantity	Price
1776	Great Britain	570	200
	Holland	126	200
	Sweden	70	200
	Italy	128	200
1796	Great Britain	4,732	200
	Germany	32	200
	Spain	94	200
	Russia	57	200
	Denmark	300	200
1797	Germany	1,024	300

Sources: Appendix 2, F-1, F-4, and F-5.

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[182] See Barata (cited in n. 94 above), p. 27.

[183] Descriptions of cacao culture in the Amazon after 1822 include Maw (cited above in n. 93), pp. 318, 339, and 341; Herndon (cited in n. 107), pp. 244, 293–296, and 300; and Herbert H. Smith, *Brazil: the Amazons and the Coast* (New York, 1879), pp. 110–114.

[184] As yet unsuperseded is Clovis Caldeira, *Fazendas de cacao na Bahia* (Rio de Janeiro, Ministério da Agricultura, 1954). Two United States scholars are currently studying socio-economic aspects of the Bahian cacao industry, Mr. Angus Wright (California State University, Sacramento) and Professor Eul-Soo Pang (Vanderbilt University).

[185] Barata, pp. 29–30, 37–38, and 47.

TABLE 10

Estimates of New World Cacao Exports to Europe, 1770–1819
(000 pounds per year)

Decade	British West Indies	French West Indies	Dutch Surinam	Venezuela	Quito	Brazil	Total	Per cent Brazil	Per cent dominant supplier
1770–1779	n.a.	1,183	525	5,975–6,300	952	1,681	10,316–10,641	16.3 15.8	57.9 59.2
1780–1789	n.a.	1,136	620	3,416	1,134	1,986	8,292	23.95	41.2
1790–1799	n.a.	21	317	8,800	2,200	2,028	13,366	15.2	65.8
1800–1809	n.a.	n.a.	166	6,210	2,200	4,320	12,896	33.5	48.2
1810–1819	246	88	93	3,208	8,100	3,674	15,409	23.8	52.6

Per cent Brazilian (means): 22.2 to 22.8

Sources: See notes 25, 33, 73, 75, 77, 78, 80, 86, and 88; also table 5 and Appendix I.

It was also shortly after the turn of the twentieth century that Guy S. Callender advanced the so-called staple thesis to explain colonial economic development. According to Callender, the prosperity of a colony or of a colonial region depended upon the development of a major export staple for which there was a metropolitan demand.[186] In subsequent years scholars have applied the staple thesis to explain certain aspects of the economic growth of Canada, Australia, and the United States,[187] but its applicability to colonial Latin America has rarely been recognized. Certainly in those areas where cacao became a dominant export, such as Venezuela, Ecuador, and the Brazilian Amazon, it provided as compelling a case to support the Callender thesis as do the furs of Canada, the tobacco of the Chesapeake colonies, or the sugars of the Caribbean. With respect to the Amazon, it is evident from the foregoing pages that before the development of the cacao industry there was scant reason for shipowners to send their vessels to the port of Belém, for there was little to pay for the cost of the voyage and no significant demand for the Amazon's products in Europe. The European-controlled population was therefore very small and the Amazon's economy was stagnant. Like tobacco, dyestuffs, and true spices, cacao was a low bulk commodity whose marketability in Europe encouraged ships to call regularly at Belém. Cargo space unneeded for cacao could be filled with other Amazonian products, such as spices, hides and—later in the eighteenth century—cotton, coffee, and especially rice. As with the exports of Ecuador and Venezuela, it was cacao that paid most of the freight. And it was cacao that encouraged settlement of the Amazon during the eighteenth century and that provided a large share of the crown's income from that region. In the long run, however, cacao may have been disadvantageous to regional economic growth. Certainly it did not bring about unlimited prosperity. As with staples in other production areas, prosperity for some, such as the merchants of Belém and Lisbon, meant misery for others, including the Indian paddlers, black slaves, and many marginal orchard owners.[188] But who the people who profited actually were and how much they benefited from the cacao industry are questions to which answers still need to be discovered.

There are others. The existence in this period of a rudimentary but remarkably sensitive international market system by which price changes in one European entrepôt were rapidly transmitted to other entrepôts and were reflected back to the various colonial producing areas clearly warrants further investigation. Much remains to be learned about the relative costs of production and profit margins that obtained contemporaneously in each of the cacao-growing regions. The same is true with respect to the precise reasons why cacao developed when and where it did. Who were the most successful planters and merchants and to what extent have their records survived? And to what degree can the rapidly growing demand for cane sugar in Europe during the sixteenth to the early nineteenth centuries be related to increasing consumption of Far Eastern teas, Near Eastern coffees, and New World cacaos? These are a few of the more tantalizing questions concerning one of the major beverage trades that await the future investigator.

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[186] Guy Stevens Callender, *Selections from the Economic History of the United States 1765–1860* (Boston, 1909), pp. 6–9.

[187] For a review of the literature, see Irene W. D. Hecht, "The Virginia Colony, 1607–1640: a Study in Frontier Growth" (Ph.D. diss., University of Washington, 1969), chap. IX, where the staple thesis is also applied to the economic history of early Virginia.

[188] In spite of the growth of commerce between Portugal and the Amazon during the last half-century of the colonial period, the *balanças gerais* used in this study make clear that the Amazon continued to remain a distant fifth among the administrative units of Brazil most actively engaged in trade with the kingdom.

APPENDIX

1. Cacao Exports from Belém do Pará, 1730–1822

Year	Price réis per Arroba[a]	Quantity in pounds	5-Yr. moving average	Source[b]
1730	4,000	706,070	902,901	A
1731	4,800	519,335	906,315	A
1732	4,800	1,047,743	1,083,363	A
1733	4,800	837,899	1,242,174	A
1734	4,800	1,413,440	1,274,823	A
1735	4,200	713,158	1,211,075	A
1736	3,600	1,404,576	1,283,020	A
1737	3,600	1,841,797	1,371,555	A
1738	3,600	1,001,144	1,362,688	A
1739	3,600	1,094,701	1,567,573	A
1740	3,000	1,072,882	1,885,117	A
1741	2,800	1,847,251	2,036,172	A
1742	2,400	1,797,465	1,711,638	A
1743	1,500	2,025,568	1,897,612	A
1744	1,500	2,682,419	1,865,623	A
1745	1,200	1,828,159	1,753,722	A
1746	1,200	224,578	1,756,819	A
1747	800	2,727,337	1,982,437	A
1748		none		
1749	1,200	2,234,815	1,617,675	A
1750	1,000	1,840,511	1,236,669	A
1751	1,000	1,127,085	1,239,769	A
1752	1,000	628,778[c]	1,204,757	A
1753	1,100	2,257,188	1,304,568	A
1754	1,100	329,781	904,077	A
1755	1,000	1,856,011	991,506	A
1756	1,200	952,029	920,611	B
1757	960	1,127,829	960,983	B
1758	960	254,737	1,057,922	B
1759	1,500 and 2,000	766,925	931,486	B
1760	2,000	1,501,537	1,277,269	B
1761	2,000	1,153,888	1,179,275	B
1762	2,000 and 2,500	1,612,522	1,152,944	B
1763	1,500 and 1,600	1,072,559	1,017,368	B
1764	1,500	1,045,839	1,065,090	B
1765	1,500	1,011,565	862,090	B
1766	1,500	1,022,234	987,777	B
1767	1,500	934,642	1,030,003	B
1768	1,500	1,311,171	1,190,998	B
1769	1,500	30,840	1,304,986	B
1770	1,500	1,639,977	1,325,135	B
1771	1,500	1,233,387	1,463,751	B
1772	1,500	1,739,593	1,590,880	B
1773	1,500	1,881,114	1,709,572	B
1774	1,500	131,597	1,693,360	B
1775	1,500	2,333,056	2,037,501	B
1776	1,500	1,869,029	1,957,423	B
1777	1,500	2,208,224	1,842,759	B
1778	n.a.	1,924,893	1,751,392	C
1779	n.a.	1,852,305	1,693,559	C
1780	1,400 and 1,500	1,932,667[d]	2,151,076	C
1781	1,400 and 1,500	1,295,705[e]	1,878,882	C
1782		n.a.	2,344,352	
1783		n.a.	2,377,631	
1784	1,500	3,224,856	2,158,503	C
1785	1,500 to 1,800	1,116,085	1,886,151	C
1786	1,500 to 1,800	2,692,115[f]	1,984,915	C
1787	1,300 to 1,500	2,477,468	1,740,875	D-1
1788	1,500	1,281,989[g]	1,556,726	D-2
1789	1,000	1,863,400[g]	1,548,210	D-3
1790	700 to 1,000	1,609,603	1,566,462	D-4
1791	850 to 1,000	1,471,913	1,751,036	D-5
1792		n.a.	1,767,985	
1793	1,600	1,247,925	1,889,806	D-6
1794	1,400 to 1,700	1,936,405	2,244,171	D-7
1795	2,000 to 2,200	2,347,899	2,396,423	D-8
1796	2,400[h] to 2,600	1,539,712[h]	2,740,802	E-3
1797	2,100	2,377,088	2,845,499	E-4
1798	2,200	3,019,752	3,257,563	E-5
1799	3,200	2,697,664	3,317,016	E-6
1800	2,400	4,069,792	3,504,620	E-7
1801	1,900	2,063,200	3,279,928	E-8
1802	1,150	4,437,408	4,460,728	E-9
1803		n.a.	3,383,326	
1804	1,750	3,448,080	4,511,168	E-10

APPENDIX—*Continued*

Year	Price réis per Arroba[a]	Quantity in pounds	5-Yr. moving average	Source[b]
1805	3,100	3,171,024	4,338,083	E-11
1806	2,400	6,786,400	3,537,245	E-12
1807	2,300	4,639,168	3,444,067	E-13
1808	n.a.	526,880	2,760,371	C
1809	2,600	6,566,944	3,584,406	E-14
1810	n.a.	3,366,832	3,407,933	C
1811	n.a.	2,120,512	3,100,927	C
1812	n.a.	3,130,688	4,058,317	C
1813	1,200	2,737,056	4,238,298	E-15
1814	n.a.	5,684,576	4,341,299	C
1815	n.a.	4,648,800	4,005,480	C
1816	2,000	4,090,464[i]	3,791,040	E-16
1817	n.a.	4,030,592	3,426,773	C
1818	n.a.	3,252,064	3,536,277	C
1819		n.a.		
1820		n.a.		
1821	2,300	2,997,664		E-17
1822	2,280	4,359,104		E-18

[a] f.o.b. Belém.

[b] See appendix 2.

[c] Cargo of the single vessel that called at Belém that year. It will be noticed that there are other years, such as 1754 and 1758, when the small volume of exports may have been carried by one ship.

[d] The "Mappa[s] da[s] carga[s] que leva . . . deste Porto para o de Lisboa," 7 Feb. to 28 Nov., 1780, AHU/PA/Pará, cx. 41, give a lower total (41,740 arrobas or 1,335,680 lbs.) but are probably incomplete.

[e] The Mapas for 27 Jan. to 3 Sept., 1781 (*loc. cit.*) are evidently an incomplete series, but the sums given above are exactly corroborated by the "Mappa da carga e de valor dos generos . . . q. do porto da cidade de Para transportarao para o de Lisboa . . . 1781," *ibid.*, cx. 42.

[f] The Mapas for 17 Jan. to 8 Nov., 1786 (*ibid.*, cx. 44) indicate a lower value for the year's exports but are probably incomplete.

[g] The available Mapas for these years are likely incomplete.

[h] The Mapas for 1796 (*ibid.*, cx. 47) are probably incomplete. The indicated price is taken from this series but is significantly higher than that quoted in the Balança for 1796 (source E-1) which was 2,090 rs.

[i] Barata (source C) gives a lower total: 3,962,464 lbs.

2. STATISTICAL SOURCES

A- "Mappa dos differentes generos que dos livros d'alfandega da cidade do Pará consta se exportarao' do seu porto des de [*sic*] . . . 1730 athe . . . 1755," encl. in J. P. Caldas to Martinho de Melo e Castro, 31 Aug., 1778, AHU/PA/Pará, cx. 38.

B- "Volume e valor do cacao exportado de Belém para Lisboa (1756–1777)," in Manuel Nunes Dias, "As frotas de cacao . . .," *RHSP* 24 (1962): facing p. 368; *cf.* "Mappa geral dos generos da producceo' do Pará e Mar.^{am} que a companhia geral daquellas estados tem arrematado em leiloes desde . . . 1758, athe Agosto de 1777," AHU/PA/Pará, cx. 37.

C- Manuel Barata, *A Antiga producção e exportação do Pará*, pp. 4–10.

D-1 "Mappa[s] da[s] carga[s] deste porto [do Belém] p^{a} o [porto] de Lx^{a}," 20 Jan. to 27 Dec., 1787, AHU/PA/Pará, cx. 44.

D-2 "Mappa[s] da[s] carga[s] . . . ." 23 Jan. to 18 Aug., 1788, *loc. cit.*

D-3 "Mappa[s] da[s] carga[s] . . . ." 13 Jan. to 3 Dec., 1789, AHU/PA/Pará, cx. 45.

D-4 "Mappa[s] da[s] carga[s] . . . ." 3 Jan. to 24 Nov., 1790, *loc. cit.*

D-5 "Mappa[s] da[s] carga[s] . . . ." 20 Feb. to 27 Nov., 1791, *loc. cit.*

D-6 "Mappa da carga . . . que exportárao . . . do [porto de Belém] do Pará p.^{a} os de Lisboa, Porto, Maranhão e Bahia no anno de 1793," *ibid.*, cx. 46.

D-7 "Mappa[s] da[s] carga[s] . . . ." 29 Jan. to 22 Oct., 1794, *loc. cit.*

D-8 "Mappa[s] da[s] carga[s] . . . ." 21 Feb. to 27 Dec., 1795. AHU/PA/Pará, cx. 47.

D-9 "Mappa dos effeitos exportados da cidade do Maranhão para Lisboa no anno de 1779," BNL/FG, cod. 7194.

D-10 "Mappa dos effeitos exportados da cidade do Maranhão para Lisboa no anno de 1780," *loc. cit.*

D-11 "Mappa dos effeitos exportados da cidade do Maranhão para Lisboa no anno de 1781," *loc. cit.*

E-1 "Balança geral do comércio do reino de Portugal com os seus dominios em o anno de 1776," BNL/FG, cod. 10522; another copy in AMOP.

E-2 "Balança . . . do comércio . . . de Portugal com os seus dominios . . . 1777," AMOP.

E-3 "Balança . . . do comércio . . . de Portugal com os seus dominios . . . 1796," INE.

E-4 "Balança . . . do comércio . . . de Portugal com os seus dominios . . . 1797," INE.

E-5 "Balança . . . do comércio . . . de Portugal com os seus dominios . . . 1798," AMOP.

E-6 "Balança . . . do comércio . . . de Portugal com os seus dominios . . . 1799," INE.

E-7 "Balança . . . do comércio . . . de Portugal com os seus dominios . . . 1800," INE.

E-8 "Balança . . . do comércio . . . de Portugal com os seus dominios . . . 1801," INE.

E-9 "Balança . . . do comércio . . . de Portugal com os seus dominios . . . 1802," INE.

E-10 "Balança . . . do comércio . . . de Portugal com os seus dominios . . . 1804," INE.

E-11 "Balança . . . do comércio . . . de Portugal com os seus dominios . . . 1805," INE.

E-12 "Balança . . . do comércio . . . de Portugal com os seus dominios . . . 1806," INE.

E-13 "Balança . . . do comércio . . . de Portugal com os seus dominios . . . 1807," BNL/FG, cod. 9198.

E-14 "Balança . . . do comércio . . . de Portugal com os seus dominios . . . 1809," *ibid.*, cod. 9197.

E-15 "Balança . . . do comércio . . . de Portugal com os seus dominios . . . 1813," *ibid.*, cod. 10715.
E-16 "Balança . . . do comércio . . . de Portugal com os seus dominios . . . 1816," *ibid.*, cod. 10716.
E-17 "Balança . . . do comércio . . . de Portugal com os seus dominios . . . 1821," *ibid.*, cod. 234.
E-18 "Balança . . . do comércio . . . de Portugal com os seus dominios . . . 1822," AMOP.
F-1 "Balança geral do comércio do reino de Portugal com as naçoens estrangeiras no anno de 1776," BNL/FG, cod. 10714.
F-2 "Balança . . . do comércio . . . de Portugal com as naçoens estrangeiras . . . 1783," AMOP.
F-3 "Alfabeto das importaçoens e exportaçoens do reino de Portugal com as naçoens estrangeiras . . . 1789," AMOP.
F-4 "Balança . . . do comércio . . . de Portugal com as naçoens estrangeiras . . . 1796," INE.
F-5 "Balança . . . do comércio . . . de Portugal com as naçoens estrangeiras . . . 1797," INE.
F-6 "Balança . . . do comércio . . . de Portugal com as naçoens estrangeiras . . . 1799," INE.
F-7 "Balança . . . do comércio . . . de Portugal com as naçoens estrangeiras . . . 1800," INE.
F-8 "Balança . . . do comércio . . . de Portugal com as naçoens estrangeiras . . . 1801," INE.
F-9 "Balança . . . do comércio . . . de Portugal com as naçoens estrangeiras . . . 1804," INE.
F-10 "Balança . . . do comércio . . . de Portugal com as naçoens estrangeiras . . . 1805," INE.
F-11 "Balança . . . do comércio . . . de Portugal com as naçoens estrangeiras . . . 1806," INE.
F-12 "Balança . . . do comércio . . . de Portugal com as naçoens estrangeiras . . . 1807," BNL/FG, cod 9199.

3. DETERMINING POSSIBLE PROFITS IN THE CACAO INDUSTRY

Because of the paucity of data, it is difficult to determine the margin of profits in the cacao trade. In 1731 the Overseas Council rejected a petition from the cathedral chapter of Belém seeking an increase in its yearly stipends, pointing out that the chapter was paid in cacao, cloves, and sarsparilla which were sold in Lisbon at twice their value in Belém. As an example, the Council noted that cacao priced in Belém at 3,000 réis per arroba fetched 6,000 réis in Lisbon (Overseas Council to king, 9 Apr. 1731, AHU/PA/Pará, cx. 6 [orig.]). However, the Council failed to consider the cost of packaging, carriage, and export and import taxes. A rare surviving bill of lading for the same decade indicates the nature of some of these expenses for:

15 sacks of cacao (2,235 lbs. at 3,600 réis/arroba)			251,437 réis
3 hampers of cloves (96 lbs. at 5,400 réis/arroba)			16,200 "
Expenses			
Export duties on cacao (410 réis/arroba)	28,628		
Same on cloves (620 réis/arroba)		1,860	
Sacking for cacao (500 réis/sack)	7,500		
Hampers for cloves (200 réis/ea.)		600	
Fee to royal treasurer			320 "
Fee to secretary of same			300 "
	36,128	2,460	39,208

("Carreg.am com o favor de Ds. desta cidade do Pará pa a de Lisboa, feitta por mim Joseph Migl. Ayres, e por minha Capm Domingos Dantas, a entregar na ditta cidade ao Rno. P^{e}. Jacinto de Carvo. da Compa. de Jesus," n.d. [*ca* 1736–1739], BNL/FG, cod. 4529 [no fol.]). Thus, the listed costs per arroba of cacao amounted to 518.5 réis (sacking: 100; tax, 410; fees 8.5). However, freight and insurance (the latter being unlikely) are not included. Presumably carriage charges were lower than they had been earlier in the century (see n. 121 above). Assuming that they amounted to 500 réis per arroba (a reasonable guess) and that the Lisbon price remained 100 per cent higher than that in Belém (it was probably now less), gross profits amounted to 56.5 per cent, but from that amount would be deducted import taxes and commission fees (amounts still to be determined). By the late 1740's the profit margin was clearly lower than it had been a decade earlier. In 1744, when the f.o.b. price at Belém was 1,500 réis/arroba, a Lisbon merchant auctioned a shipment of 3,996 lbs. of cacao for only 2,010 réis/arroba. (Memorandum [signature illegible] dated Lisbon, 27 Jan., 1745, AHU/PA/Pará, cx. 12.) But by 1760 the profit margin was apparently much greater. (See n. 167 and the text at that point.)

LEARNING IN LATE PIAST POLAND

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WHEN Casimir the Great of Poland died at the age of sixty on 5 November, 1370, the princes, prelates, and populace of Poland mourned his passing with grief which Janko of Czarnków later reported was beyond human ability to describe.[1] That they should do so was not surprising, for the last ruler from the Piast dynasty had been both a beloved and respected king.[2] More than this, however, it was recognized that in his reign, Casimir had succeeded in restoring the internal health and international prestige of the kingdom. At the same time, he had been successful in furthering a general cultural advance, which, if not so brilliant as in *trecento* Italy, was nevertheless substantial.

This study seeks both to summarize the general outlines of this flourishing as it appeared in the last century of rule by the native Piasts and to indicate the ways in which the influence of Casimir in particular may be observed in specific areas of learning. After a very brief summary of the heritage of the thirteenth century and the political, administrative, and economic achievements of the late Piasts, particular attention will be given first to the context of learning (i.e., literacy, libraries, and schools), and then to accomplishments in the fields of law, literature, historical writing, and philosophy.

Although by no means everything in these areas can be related directly to royal instrumentality, it will be possible in what follows to see the ways in which Casimir fostered learning for state purposes, most clearly in the realm of higher schools and of law. In historical writing, his indirect presence may also be observed, for it is the restored *regnum* over which he and his father presided that is celebrated in the narratives to be analyzed. Other areas of learning, such as literature and philosophy, were less affected by royal initiative, but they are nevertheless important as components in Poland's growing cultural maturity. Although it will in some instances be necessary to overstep the following *termini*, the period upon which this study focuses lies between the last decade of the thirteenth century and the accession in 1384 of Jadwiga as ruler of Poland.

I. THE LATE PIAST HERITAGE

The thirteenth century was not a happy time in the history of Polish civilization. Forces of localism had earlier triumphed in the political sphere, and throughout the century the *regnum Poloniae* was riven by particularism and petty factionalism which temporarily destroyed the unity of the state. In this time there was no Poland; there were only powerful Piast princelings in Greater Poland, Mazovia, Kujavia, Little Poland, and Silesia. Throughout the century they vied inconclusively for predominance, their ambitions causing political order and stability even on the local level to degenerate into near anarchy.

At the same time, Poland was confronted by growing external dangers. The territorial ambitions of the Ascanian dynasty in Brandenburg and the consolidation of the power of the Teutonic Knights both came at the expense of Polish interests. From the north and east also came frequent raids by Prussians, Jatvings, and Lithuanians which exacerbated internal problems. But the most dramatic blow from abroad in the

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[1] Janko of Czarnków, *Chronica Polonorum*, in: *Monumenta Poloniae Historica*, Series I [hereafter cited as *M.P.H.*] (6 v., Lwów, 1864–1893 [vol. 6, Cracow]), 2: p. 636: "Quantus enim clamor, quantus fletus, quanta vociferatio procerum et nobilium, praelatorum, canonicorum et ecclesiasticorum virorun atque popularium in sua depositione extitit, lingue humana non facile posset enarrare."

[2] Posterity has traditionally ascribed to Casimir the title of "The Great." See the useful analyses of this appellation by Jerzy Wyrozumski, *Kazimierz Wielki i jego dzieło (1333–1370)* (Cracow, 1971), pp. 26 ff., and "Kazimierz Wielki i jego czasy w nowszej historiografii polskiej," *Studia Historyczne* 13 (1970): pp. 337–356.

thirteenth century was undoubtedly the Mongol attacks of mid-century. Their invasion of Little Poland and Silesia in 1241 left an impression which menaced the Polish mind for generations, while later raids in 1259 and 1287 were destructive of both town and countryside.[3]

Despite the very real difficulties sketched above, Polish culture in this period showed a considerable vitality that was rooted in native traditions and local needs but stimulated and shaped by developments and influences from the west. Out of the spiritual needs of the people came certain religious compositions in the vernacular to complement the beginnings of court and folk literature, the fourteenth-century elaboration of which we shall trace below. To celebrate Poland's role in European civilization and its ties to antiquity, Bishop Vincent Kadłubek of Cracow composed an ambitious *Cronica de gestis principum ac regum Poloniae* in the early part of the century; through the next decades historical materials were compiled in various *Annales* (*Roczniki*). These were to culminate in the *Chronica Poloniae Maioris*, the first great historiographical achievement of late Piast Poland (see below). The thirteenth century was also characterized by a growing network of schools within Poland which elevated the level of learning among both the clergy and even the laity.[4] In addition, Poles traveled in the west to study at the universities of Italy and France. For example, the aforementioned Kadłubek and his successor at Cracow, Iwo Odrowąż, both studied law at Bologna, while the Silesian scientists Vitelo and Franko attended Paris. In the area of the fine arts (which are not further treated in this study), the sculptural styles of the Rhineland, Burgundy, and northern Italy were brilliantly adapted to the aesthetic needs of the native aristocracy, as in the Praemonstratensian nunnery at Strzelno; while architecturally, the flowering of the Romanesque blended smoothly with early Gothic forms, as in Sulejów and Wąchock. In sum then, a broadly based cultural development took place within the otherwise unpromising conditions of the thirteenth century. With the subsequent political, social, and economic advance of Poland under its last Piast rulers, it is not surprising that culture, particularly learning in the broad sense, should also show a corresponding flowering.[5]

On the eve of the fourteenth century, inspired by a Polish church which had never been disunited, stimulated by the increasing cohesion of the Polish gentry, catalyzed by the growing threat from abroad, and led vigorously by a series of ambitious and powerful Piast dukes, a movement toward political unification emerged.[6] First attempted by Henry IV Probus of Silesia in 1289/90, it was achieved temporarily under Przemysł II of Greater Poland in 1295/96 and finally accomplished permanently by Władysław Łokietek of Kujavia. In 1320 the *regnum Poloniae* was restored with the coronation of Łokietek. During the following half-century he and his son strengthened the state internally, while the latter made peace with Poland's enemies, recovered several lost territories in the west, and nearly doubled the size of the kingdom by conquests and feudal incorporations in the east. By 1364 Poland had reemerged as an important regional power. In that year the crowned heads of east central Europe gathered in Cracow to discuss a crusade against the Turks and to celebrate the founding of the University of Cracow. Since Casimir left no direct heir at his death, rule in Poland for the next decade and one half was exercised in turn by his older sister Elizabeth on behalf of her son King Louis of Hungary, and by the emerging ruling oligarchy from Little Poland. It was they who eventually "accepted" the rule of Queen Jadwiga and obtained Władysław Jagiełło from Lithuania as her husband, thus initiating in 1385/86 both a new dynasty and a new age in Polish history.

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[3] The standard treatment of the Mongol impact upon Poland is now Stefan Krakowski, *Polska w walce z najazdami tatarskimi w XIII wieku* (Warsaw, 1956). I have elsewhere discussed briefly one aspect of this impact. See "Poland as *Antemurale Christianitatis* in the Late Middle Ages," *Catholic Hist. Rev.* **50** (1974): pp. 385–386.

[4] The continuing historiographical debate on the history of parish schools in the three centuries following the Christianization of Poland has been summarized for western scholars, and new materials on the subject have been added, by Eugeniusz Wiśniowski, "The Parochial School System in Poland towards the Close of the Middle Ages," *Acta Poloniae Historica* **27** (1973): pp. 29-44; and Jerzy Dowiat, "Le livre et l'école dans l'éducation des laics en Pologne et dans les pays voisins du Xe au XIIe siècle," *Acta Poloniae Historica* **28** (1973): pp. 7-22.

[5] Thirteenth-century Polish culture has yet to receive adequate attention in Polish historiography. Important new contributions in this area are reflected in the papers delivered at the Ninth Congress of Polish Historians in Warsaw in 1963 and published under the title *Historia kultury średniowiecznej w Polsce* **1**: *Referaty* (Warsaw, 1963). On the arts in this period see Jan Zachwatowicz, *Architektura Polska* (Warsaw, 1966), pp. 11–57; and Michał Walicki, *et al.*, eds., *Sztuka Polska, przedromańska i romańska do schyłku XIII wieku* (2 parts, Warsaw, 1971), pp. 149–194, 214–224, and 235–245 especially.

[6] Much of what follows is drawn from Zdzisław Kaczmarczyk, *Monarchia Kazimierza Wielkiego* (2 v., Poznań, 1939–1946), for internal affairs, and from my book *The Rise of the Polish Monarchy, Piast Poland in East Central Europe, 1320–1370* (Chicago, 1972), for foreign policy.

In other respects the nearly one hundred years before Jadwiga saw important developments within the kingdom. There was an attempt to reform the currency, new taxes were successfully introduced, royal lands which had earlier been alienated or let out on unprofitable leases were returned, and the mineral resources of the kingdom were regulated and developed. The increased income from these measures enabled Casimir, in particular, to effect other important reforms. He had more than fifty royal fortresses built within the kingdom, encouraged the construction of stone defensive walls in at least twenty-seven cities. and organized a defensive force for the kingdom, the *pospolite ruszenie* (a non-feudal *levée en masse* of both the greater and lesser nobles organized under native administrators). In the area of administrative centralization, the last Piasts were particularly successful. They strove consistently to develop an administration which was not merely local and regional, but which was national and royal. Gradually there emerged, especially in the last two decades of Casimir's reign, a corps of administrators, many of them university trained, who increasingly acted as royal functionaries. The culmination of this program may be seen after 1364, when the vice-chancellor of Cracow, Janko of Czarnków, began to style himself *vicecancelarius regni Polonie,* and to be described by the king as *vicecancelarius regni nostri.*[7] The development of a more centralized administration also meant changes in the nature of Polish law. To this question we shall devote attention below.

II. THE CONTEXT OF LEARNING

One of the criteria which reflect the level of learning at any given time in the Middle Ages is that of Latin literacy. Among the laity, a degree of this has long been recognized as a feature of medieval society;[8] and although schooling was by no means widespread beyond the clergy, Polish laymen were no strangers to education in this period. Several individuals may be identified as in some degree learned.

The first of these is Duke Henry IV Probus of Silesia.[9] In his youth he was educated at the cathedral school of Wrocław and in Prague at the Bohemian court of his uncle King Přemysl Otakar II. From this came an ability both to read and to write in Latin. Contemporaries reported that his favorite book was the life of the martyred Saint Stanisław, Bishop of Cracow (d. 1079, canonized 1257), who had become in the late thirteenth century the subject of a widespread cult and the symbol of Polish national unity. Among the duke's writings was poetry which was apparently highly esteemed in his day, but is now lost.

No Piast prince after Probus could match this learning. Przemysł II of Greater Poland and King Władysław Łokietek were both practical, simple warriors who almost certainly were not literate. About Casimir the Great we cannot be so certain. Although the commonly held view is that he could neither read nor write,[10] two factors suggest that this may be incorrect. The first is that the future king's upbringing was entrusted to Spicymir of Melsztyn and Jarosław Bogoria. The former was a learned legal administrator and patron of learning; the latter, a university-trained high churchman and the king's eventual collaborator in the codification of Polish law. In light of Casimir's later concern for education and learning, it is possible these men provided him with the fundamentals of literacy. This impression is reinforced by a second factor: two of Casimir's cousins, Dukes Leszek and Kazimierz of Kujavia, were literate, having been able to testify without the benefit of an interpreter in a legal suit against the Teutonic Knights in 1339.[11] If these minor princelings from a junior branch of the Piast line possessed some learning, perhaps the same may also be said of their royal cousin.

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[7] See the documents cited by Karol Maleczyński, *Zarys dyplomatyki Polskiej wieków średnich* 1 (Wrocław, 1951): p. 271. I hope to devote a further study to the question of royal administration in late Piast Poland.

[8] James Westfall Thompson, *The Literacy of the Laity in the Middle Ages* (Berkeley, California, 1939), pp. 1, 196. Thompson also discusses other instances of lay literacy in earlier medieval Poland (pp. 93 f., 100).

[9] There is a substantial literature on Henry IV. Recently Józef Mitkowski has written a short, authoritative entry (with bibliography and evaluation of sources) for the *Polski Słownik Biograficzny* [hereafter cited as *P.S.B.*] (Cracow [later also Warsaw and Wrocław], 1935 ff.) **9**: pp. 405–408.

[10] Most scholars have accepted the simple assertion of Stanisław Zakrzewski, *Zagadnienia historyczne* (2 v., Lwów, 1936) **2**: p. 157: "If at that time the king of France [Charles IV] did not know how to read, perhaps the same thing may be said about Casimir also."

Elsewhere in society there is evidence to indicate that literacy was beginning to spread into the ranks of the laity. For example, although there were no literate lay witnesses who testified in a judicial process against the Knights in 1320, at least eleven were called to a similar process nineteen years later who could be classified as literate. Two were the aforementioned dukes of Kujavia, and it is recorded about Duke Leszek ". . . that he who was giving testimony had seen and read the document that had been prepared regarding this concession. . . ." Another two, Stephen of Sieradz and Andreas of Poznań,[12] were drawn from the nobility; two more came from commercial ranks in Cracow: Nicolaus and Johannes;[13] while the remainder were representatives of the towns within the *regnum*: Johannes of Pobediscz, Johannes of Unejów, Goczwinus of Szadek, Johannes of Kalisz, and Petrmannus of Slavessino.[14] While this is far too narrow a statistical base upon which to generalize, it does suggest the soundness of Alexander Bruce Boswell's observation that "not only in the towns, but among the gentry too, the ability to read and write spread rapidly. The day of the illiterate, hard-fighting knight was passing."[15]

Among the clergy of late Piast Poland it is of course not unusual to find Latin literacy. In comparison to previous generations, however, there was a surprisingly high level of education which went far beyond the basic instruction of the monastic and cathedral schools which will be discussed below. This was due to the fact that, after a slow start in the thirteenth century, Polish churchmen were increasingly obtaining university education in the west.

In Wrocław alone the cathedral chapter could count thirty-one individuals in the second half of the thirteenth century and another twenty-five in the decades from 1300 to 1341 who had received some university education. Ten of these were known as either *doctor decretorum* or *doctor legum*.[16] These students were part of a movement which was but a thin stream from beyond the Oder in the thirteenth century, but which had grown into a moving tide by the time of Casimir.

Many of these were men trained in law at the universities of northern Italy. Two different individuals named Stephanus Polonus, a certain Lawrence (Wawrzyniec), and Jacobus of Skaryszew studied in the west, wrote works quoted by the canonists of the late thirteenth and fourteenth centuries, and returned to Poland where their legal knowledge was utilized among the various groups of Polish society.[17] Jan Pakosławowicz, an important royal ambassador under Casimir, and Dobiesław, an ecclesiastic from Gniezno, both studied canon law in Padua in this period.[18] But the most important Polish students in cis-Alpine universities were three who were uniquely involved with the intellectual life of late Piast Poland. Jarosław Bogoria, later archbishop of Gniezno and codifier of Polish law, studied at Bologna, as did his nephew Janusz Suchywilk, *doctor decretorum,* chancellor of Cracow, and his uncle's successor at Gniezno. The third was Janko of Czarnków, Casimir's last vice-chancellor and a historian of note, who was recognized by contemporaries as *iuris peritus,* an appellation which would suggest Italy.[19]

Other Poles attended the universities of the north, particularly France. In 1313 five students at Paris, Demaiudus, Nicolaus, Vincentius, Hanto, and *magister* Mathias, *omnes de Polonia,* appealed directly to the pope in an internal university dispute;[20] while a quarter-century later, in 1337/38, *magister* Andreas de Polonia and *magister* Petrus de Polonia were involved at Paris in matters of both administration and philosophical debate.[21] Altogether in the fourteenth century there were at least a dozen Poles who earned degrees at Paris. There were, in addition, many more who attended but did not graduate.[22]

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[11] *Lites ac res gestae inter Polonos Ordinemque Cruciferorum*, editio altera by I. Zakrzewski and J. Karwasińska [hereafter cited as *Lites*] (3 v., Poznań and Warsaw, 1890–1935) **1**: p. 375 (witness 105), and p. 281 (witness 43).

[12] *Lites* **1**: p. 214 (witness 18), and p. 327 (witness 68).

[13] *Lites* **1**: p. 384 (witness 112), and p. 385 (witness 113).

[14] *Lites* **1**: p. 362 (witness 93), p. 225 (witness 23), p. 270 (witness 40), p. 312 (witness 54), and p. 311 (witness 53).

[15] Alexander Bruce Boswell, "Cultural and Social Conditions in the Middle Ages," in *The Cambridge History of Poland,* edited by W. F. Reddaway, *et al.* (2 v., Cambridge, 1941–1950) **1**: p. 158.

[16] See the detailed analysis in Robert Samulski, *Untersuchungen über die persönliche Zusammensetzung des Breslauer Domkapitels im Mittelalter bis zum Tode des Bischofs Nanker (1341)*, part 1 (Weimar, 1940): pp. 88–99.

[17] Adam Vetulani, "Kanonista Stephanus Polonus," in: *Prace z dziejów Polski feudalnej, ofiarowane Romanowi Grodeckiemu w 70 rocznicę urodzin* (Warsaw, 1966), pp. 153–165. See also J. F. von Schulte, *Die Geschichte der Quellen und Literatur des kanonischen Rechts von Gratian bis auf die Gegenwart* (reprinted Graz, 1956) **2**: p. 170; and *P.S.B.* **10**: p. 346 f.

[18] See *Monumenta Poloniae Vaticana* [hereafter cited as *M.P.V.*] **3**: *Analecta Vaticana, 1202–1366,* ed. Jan Ptaśnik (Cracow, 1914), pp. 421 and 447.

[19] These men are discussed below; the sources for their lives are presented in *P.S.B.* **11**: pp. 1–3; **10**: pp. 583–585; and **10**: pp. 446–449 respectively.

Not all who stayed in the north studied at the *Parens scientiarum.* Those who were interested in medicine might well study at the University of Montpellier. Thus in the latter years of Casimir's reign, we find Jan Radlica, who had already completed the arts course at Paris and who later became royal chancellor and bishop of Cracow, continuing his studies in medicine here. Nor was he the only Pole who went there, for sometime before 1368 one Nicolaus de Polonia is noted on the medical faculty.[23]

During the reign of Casimir there were more than sixty individuals who can be identified as having had some kind of university training: eight students, three licensees, thirty masters, a dozen doctors, and eight physicians.[24] Perhaps another score may be added from the years before and after his reign.[25] All, with the exception of a handful who studied in Prague after 1348 or Cracow after 1364, received their education in the west. Two conclusions may be drawn from the foregoing discussion of literacy and higher education abroad. First, that there was a growing body of qualified teachers to serve the needs of schools in Poland; and second, that there was demand enough within the *regnum* to support the founding of a native *studium generale.* Let us turn therefore to the question of schools and libraries within Poland and to the establishment of the University of Cracow.

The development of schools in Poland had followed much the same pattern as in western Europe: monastic centers had first taken the lead, then been eclipsed in the twelfth and thirteenth centuries by cathedral, and even some parish, schools. Altogether there were some 46 higher schools and as many as 175 parish schools which functioned in Poland in this time.[26] In these, the traditional *artes liberales* formed the basis of instruction, though it is problematic to what extent the *quadrivium* received adequate attention. In some of the more developed *studia,* if we may judge from the libraries discussed below, the rudiments of theological literacy and church law also formed part of the curriculum. But beyond this, little is known of the programs and contributions of most of these schools.

For example, in Tarnów, a parish school was founded sometime *post* 1346. Although it maintained very close contacts with St. Mary's parish and school in Cracow, the moving force in the vigor which instruction there showed was the powerful Leliwit family. The head of this clan was Spicymir of Melsztyn, castellan of Cracow and former tutor of King Casimir.[27] Even for higher schools beyond the parish level, in many instances only the bare fact of their existence has been preserved. Thus, in the fourteenth century there is evidence of the functioning of a cathedral school in Poznań,[28] one connected with the cathedral in Gniezno, and a cathedral school in Płock. Other schools were associated with the church of St. Stanisław in Kazimierz, a collegiate church in Łęczyca, monastic *studia* in Miechów, Tyniec, and Cracow (both the Franciscans and Dominicans), as well as churches in Gostyń and elsewhere.[29]

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[20] *Chartularium universitatis parisiensis,* edited by H. Denifle and E. Chatelain (4 v., Paris, 1894–1897) **2,** 1: p. 163.

[21] *Auctarium chartularium universitatis parisiensis,* edited by H. Denifle and E. Chatelain (2 v., Paris 1894–1897) **1**: pp. 22 and 30.

[22] Aleksander Gieysztor, "Mistrzowie polscy uniwersytetu paryskiego w XIV i XV wieku," in: *Wieki Średnie, Prace ofiarowane Tadeuszowi Manteufflowi w 60 rocznicę urodzin* (Warsaw, 1962), p. 220, estimates fourteen Polish graduates in the years 1333–1406. On the general relationship between matriculation and graduation, see Franz Eulenburg, *Die Frequenz der deutschen Universitäten von ihren Gründung bis zur Gegenwart* (Leipzig, 1904), p. 29.

[23] Poles at Montpellier are discussed particularly by Stanisław Kutrzeba, "Polacy na studiach w Paryżu w wiekach średnich," *Biblioteka Warszawska* **2** (1900): pp. 526 ff.

[24] This number was identified by Antoni Karbowiak, *Dzicje wychowania i szkół w Polsce w wiekach średnich* (3 v., St. Petersburg and Lwów, 1898–1923) **1**: p. 256; and revised by Kaczmarczyk, *Monarchia* **2**: pp. 323–325. See my further comments in "Casimir the Great and the University of Cracow," *Jahrbücher für Geschichte Osteuropas* **16** (1968): p. 236, n. 22.

[25] Jadwiga Krzyżaniakowa, "Związki Uniwersytetu Praskiego z Uniwersystetem Krakowskim w drugiej połowie XIV wieku," *Acta Universitatis Carolinae: Historia Universitatis Carolinae Pragensis* **5,** 1–2 (1964): pp. 119–131.

[26] Compare Oskar Halecki, "Kazimierz Wielki 1333–1370," in: *Encyklopedya Polska* (Warsaw, Lublin, Łódź, and Cracow, 1920) **5,** 1: p. 402, 2, and Karbowiak, *Dzicje wychowania i szkół* **1**: p. 126; and **2**: pp. 441–442.

[27] The school is analyzed in Zygmunt Ruta, *Szkoły Tarnowskie w XV-XVIII w.* (Wrocław, Warsaw, and Cracow, 1968), p. 13 ff. Spicymir's role is documented in Stanisław Gawęda, *Możnowładztwo małopolskie w XIV i w pierwszej połowie XV wieku* (Cracow, 1966), pp. 25–26.

King Casimir did much to support schools in Poland. For existing *studia* we find donations of books, either from among his own modest holdings or prepared at his request. He also took steps to ensure that new schools were founded. Thus in granting Bydgoszcz rights of location *de jure theutonico* in 1346, the king specified that a school be founded near the church "with the consent and at the will of the vicar." [30] In a similar manner in 1364, in connection with the founding of a church in Skawina, Casimir provided for the building of a school nearby.[31] We shall deal below with his foundation of a university in Cracow and the role it was intended to play in his efforts to foster education.

From at least two schools in late Piast Poland, there is concrete evidence about the functioning of the program: the cathedral school on Wawel Hill in Cracow and the parish school of St. Mary's church on the Cracow town square. In the former, the activity of Petrus, *dictus miles*, as *scholasticus* from 1335 to 1339 is known, while some years later (1346/47) he was succeeded by a certain Jacobus. But the most distinguished pedagogues there were the papal collectors in Poland: the Italians Arnoldus de Caucina and his assistant, Amboldo Johannes de Campino. Casimir commented in 1366 that because of them there had been ". . . sixteen years of teaching in the arts to the scholars of Sandomir and Cracow." [32] Though these men would certainly have touched upon theological matters, their interest beyond the arts lay not surprisingly in canon law. This is reflected in the composition both of the cathedral chapter in Cracow and of the chapter library. In the former, many of the members had received training in the local school, and from their later interests it is apparent they demonstrated a continuing commitment toward legal studies. There was a complete absence of members with advanced training in theology. Instead, the specialty of the chapter was law, and during this period there were a dozen *doctores decretorum,* and numerous bachelors, licensees, and students of law.[33] In the library there were many liturgical works and works of scriptural commentary, plus the theological treatises of Augustine and Aquinas. But in addition, as we shall see in more detail below, the library was rich in the works of both canon and civil law.

In the parish school of St. Mary's, the level of instruction may not have been so high. As late as 1323 Bishop Nanker of Cracow complained that the *quadrivium* was scarcely taught there.[34] But in the course of the fourteenth century conditions improved to the point where after 1364 the *studium* became associated with instruction in the liberal arts at the University of Cracow. In our period the names of provost Nicholas of Kórnik and Theodore of Damerau, both trained in law, are particularly connected with instruction at St. Mary's.[35] The vitality of the school is reflected in the detailed regulation issued in a municipal ordinance of 1379. It established fees for instruction, and suggests that there may already have been some attempt on the part of the city to supplant the bishop of Cracow as the school's patron.[36]

Yet a third educational center in Cracow needs to be mentioned at this point. Although it was not a *studium* in the strict sense, it nevertheless exercised considerable influence upon the cultural scene and was closely related to the reasons which prompted Casimir to found the University of Cracow. This center was the royal court, and particularly the royal chancery. Here were concentrated all the important questions of state, particularly those of administration, legal reform, and the execution of foreign policy.[37] As these concerns became increasingly complex, there was need to employ individuals having the educational background to deal with these questions. There was apparently some kind of program for training a *notarius* within the chancery, but education was not given there for the interpretation and execution of law. Some kind of higher institution was needed for this purpose.

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[28] See *Codex diplomaticus Maioris Poloniae,* edited by I. Zakrzewski and F. Piekosiński (5 v., Poznań, 1877–1908) **3**: no. 1360.

[29] There is a good discussion of these bare notices in Kaczmarczyk, *Monarchia* **2**: pp. 290 ff. The school in Gniezno is discussed by Brygyda Kürbisówna in the cooperative *Dzieje Gniezna,* edited by Jerzy Topolski (Warsaw, 1965), pp. 199–201.

[30] *Codex diplomaticus Poloniae,* edited by L. Rzyszczewski, A. Muczkowski, *et al.* (4 v., Warsaw, 1847–1887) **2**: p. 496.

[31] *Codex diplomaticus Tyniensis,* edited by Wojciech Kętrzyński and Stanisław Smolka (Lwów, 1875), p. 82.

[32] *Codex diplomaticus cathedralis Cracoviensis,* edited by F. Piekosiński (2 v., Cracow, 1874–1883) **1**: p. 265.

[33] Karbowiak, *Szkoła katedralna krakowska w wiekach średnich* (Cracow, 1899), pp. 28 ff.

[34] *Starodawne Prawa polskiego pomniki* **4**: *Statuta synodalia episcoporum Cracoviensium XIV et XV saeculi* . . . , edited by L. Hayzmann (Cracow and Warsaw, 1875), p. 17.

[35] See Jerzy Zathey, "Biblioteka Kościoła P. Marii w Krakowie na przełomie XIV i XV w.," *Roczniki biblioteczne* **8** (1964): *pp.* 19–21.

[36] The ordinance of 1379 is in Stanisław Estreicher, *Najstarszy zbiór przywilejów i wilkierzy miasta Krakowa* (Cracow, 1936), p. 36. The ambitions of the city to acquire control emerge clearly in the early years of Jagiellonian rule. See *Libri antiquissimi civitatis Cracoviensis,* ed. F. Piekosiński and J. Szujski, part 2 (Cracow, 1878): pp. 128, 129, 162, 202.

That there existed within Poland the general cultural conditions for the foundation of such an institution is partially demonstrated by an analysis of the contents of the most important libraries in the late Piast period. In the cathedral chapter library in Gniezno there were numerous volumes, of which forty-two have survived to the present.[38] Among these were various copies of the Bible, including one in three volumes given by Archbishop Jarosław Bogoria, the *Sentences* of Peter the Lombard, various formularies and collections of letters, and sermons. Standard medieval geographies and histories were also represented, including one of the Holy Land. The collection of legal works was particularly rich. It included Gratian's *Decretum*, the decretals of Pope Gregory IX, the Clementine *Constitutiones*, and the writings of such canonists as Gottfried of Trano, Bartholomew of Brescia, Ivo of Chartres, Peter of Milan, Johannes Theutonicus, Guilelmus Durantis, and Raymond of Pennaforte.

An even better collection was to be found in the chapter library in Cracow.[39] In addition to the liturgical and theological works mentioned above, there were two copies of Gratian's *Decretum* and the *Constitutiones Clementinae*, and single copies of the works of Bernard Papiensis, Gottfried of Trano, Guilelmus Durantis, the Institutes and Digest of Justinian, and other minor legal works. Interestingly, the library also contained a leavening of literary works by Roman authors: Ovid, Claudian, Sallust, and Terence were all represented. Altogether in mid-century there were more than sixty-two works in eighty-two volumes contained in the cathedral library.

In the Cracow parish church of St. Mary's there was nearly as fine a library. By the end of the fourteenth century there were some forty volumes, most of which were either liturgical works (such as missals, graduals, and antiphonals) or Biblical works and commentaries. The remainder included a *Vocabularium seu liber derivationum* of the canonist Hugucino of Pisa, three works by John Buridan (one entitled *Questiones metaphysica,* a set of his *Questiones super posteriorum cum commento,* the third dealing with logic), a work by Euclid, one of Albertus Magnus, a treatise by Egidius Romanus *super libros phisicorum,* and several anonymous commentaries upon one or another part of the Aristotelian corpus.[40]

Elsewhere in Poland, apart from the ecclesiastical and political centers of Gniezno and Cracow, there were also substantial collections. In the chapter library at Poznań, into which several other collections had already been merged, it is possible to identify today seven volumes of local origin, four from the monastery in Paradyż, and two from the monastery of Ląd. There are also an additional twenty codices whose provenance cannot be determined, but which can be assigned with certainty to the late Piast period.[41] This collection is not markedly different in its contents from others elsewhere in Poland, except that it add the works of Flavius Josephus, a collection of the decretals of Innocent III by Peter of Benevento, the decretals of Boniface VIII, and some minor canonists not hitherto represented in Polish holdings.

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[37] These characteristics are clearly reflected in the description of the royal chancery in Karol Maleczyński, Maria Bielińska, and Antoni Gąsiorowski, *Dyplomatyka wieków średnich* (Warsaw, 1971), pp. 201–229. See also Maleczyński, *Studia nad dokumentem polskim* (Wrocław, Warsaw, Cracow, and Gdańsk, 1971), pp. 242–276; and Kazimierz Jasiński, "Uwagi nad kancelarią Władysław Łokietka i Kazimierza Wielkiego," *Zapiski Towarzystwa Naukowego w Toruniu* **19** (1954): pp. 57–101.

[38] On the library there, see Tadeusz Trzciński, "Katalog rękopisów Biblioteki Kapitulnej w Gnieźnie aż do początku wieku XVI," *Rocznik Towarzystwa Przyjaciół Naukowy w Poznaniu* **35** (1910): pp. 169–320; and L. Formanowicz, "Biblioteka Kapitulna w Gnieźnie," in: *Biblioteki Wielkopolskie i Pomorskie*, edited by S. Wierczyński (Poznań, 1929), pp. 150 ff.

[39] The library is described in Ignacy Polkowski, *Katalog rękopisów kapitulnych katedry krakowskiej* (Cracow, 1884); and Maria Hornowska and Halina Zdzitowiecka-Jasieńska, *Zbiory rękopiśmienne w Polsce średniowiecznej* (Warsaw, 1947), pp. 193–209.

[40] This catalog is derived from a document issued in 1397 by Bishop Piotr Wysz of Cracow, printed in *Codex diplomaticus civitatis Cracoviensis,* edited by F. Piekosiński (2 v., Cracow, 1879–1882) **2**: pp. 519–529.

[41] A. Lisiecki, "Katalog rękopisów Biblioteki Seminaryjnej w Poznaniu aż do końca XV w. włącznie," *Przegląd Kościelny* **7** (1905): 283–296; Kaczmarczyk, *Monarchia* **2**: p. 295.

One further library of great importance should be mentioned in this brief survey of the intellectual resources of this period: the library of the cathedral of Płock. This picturesque Mazovian city was in the fourteenth century the capital of its province and the most important city of the region. By commission, purchase, and gifts, its cathedral gradually built up a collection which as late as 1939 still contained more than twenty-five works which were in its possession before 1385. For example, one of its canons purchased a fine copy of Guilelmus Durantis's *Rationale divinorum officiorum* in Avignon in 1359, paying the papal librarian Antonio de Sexto fifteen gold florins for it. Not long afterward, at the latest 1365, Świętosław of Wilków, upon the special request of one of the cathedral canons, prepared a magnificent antiphonal and a gradual.[42] But by far the largest single acquisition of codices came from *magister* Andreas, cantor of the cathedral. In 1354 Andreas, who studied probably at the University of Paris,[43] donated eight volumes of his own library to the cathedral. Together they form a collection of some of the best legal literature, both canon and civil, available in the fourteenth century.[44]

The *Decretales cum apparatu Bernardi* was Gregory IX's collection with the commentary of Bernard of Parma. A copy of Gratian's *Decretum* contained the extended glosses of Johannes Theutonicus; while the *Rosarium sive lectura Ioannis archidiacone Bononiensis* was the commentary of Guido of Baysio upon Gratian. The *Speculum iudiciale* of Guilelmus Durantis was a valuable handbook dealing with the processes of legal judgments, while the same author's *Repertorium* dealt with the *Decretum* and the *Decretales* of Gregory IX and Innocent IV. The *Liber Sextus* of Boniface VIII as commented upon by Johannes Andreas was also included, as was the *Instituta Iustiniani* with the notes of Accursius, an imperial glossator. The final work in the collection was the *Distinctiones Petri de Sampsone,* an explication of some of the titles in the decretal collection of Gregory IX.

With the development of numerous *studia* within the *regnum,* the presence of trained educators, and the growing resources of native libraries, it was not surprising that Poland should attempt to found a university in Casimir's time. The event which precipitated the Piast's action was the erection by Charles IV of a *studium generale* in Prague.

As one of the most highly cultured rulers of his day, the Luxemburg emperor was well aware of the role of universities in western Europe. As the crowning educational achievement of the time, they were a suitable reflection of the other successes of their founders. Charles was painfully aware of the absence of any such institution in central Europe,[45] and one of his first acts as king of Bohemia and emperor was to begin negotiations with his former tutor, now Pope Clement VI, to adorn his *coronae* with the brightest cultural jewel the age could provide.[46] Sometime in 1346 he sent a formal request to Avignon for the founding of a *studium.* This was answered by the granting on 26 January, 1347, of permission for a school in all faculties with right of inspection and promotion reserved to the archbishop of Prague. After a delay of more than a year, Charles confirmed this; and in April, 1348, there came into being the eventual Caroline University of Prague.[47] Despite the fact that apparently all parts of the university functioned from the very beginning and that it existed in a social, cultural, and political milieu highly favorable for its development, the young institution experienced numerous difficulties in its early years. As a result, the two decades after 1348 were devoted largely to the laying of foundations for its later greatness.[48] Thus it is instructive for an understanding of the problems connected with the later foundation and functioning of Cracow to examine briefly developments in Prague.

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[42] See M. Bersohn, *Księgozbiór katedry płockiej* (Warsaw, 1899); and A. J. Nowowiejski, *Płock* (2nd ed., Płock, 1930), pp. 471–475. On f. 4v of this otherwise unblemished manuscript is written in red: "Libro completo—muszysz mi dacz moge mito [you must give me my pay (mead?)]—Scriptor scripsisset melius, si potuisset. Heu, male finivi, quia scribere non bene scivi. Explicit hoc totum, in fundo da michi potum."

[43] While it has been traditional, on the basis of his library, to suggest that Andreas had been educated in Italy, probably Bologna (see for example Kaczmarczyk, *Monarchia* **2**: p. 296), Adam Vetulani, "Średniowieczne rękopisy płockiej Biblioteki Katedralnej." *Roczniki Biblioteczne* **7** (1963): p. 335, has correctly, I believe, identified him as the Andreas de Polonia mentioned by Kutrzeba, "Polacy na studiach w Paryżu," p. 526.

[44] See *Kodeks dyplomatyczny księstwa mazowieckiego,* edited by T. Lubomirski (Warsaw, 1863), pp. 67 ff., no. 75. This donation is fully described, on the basis of extensive notes taken in the 1930's, by Vetulani, "Średniowieczne rękopisy płockie," pp. 335–337. This part of the library disappeared during the last months of the Second World War.

[45] Half a century before, King Václav II had tried unsuccessfully to found a university in Prague. He had been defeated by the Bohemian nobility which feared the teaching of civil and canon law would be detrimental to their own traditional rights, privileges, and prerogatives. See W. Tomek, *Dějepis města Prahy* (3 v., Prague, 1866–1872) **3**: p. 262.

[46] Recent useful works on the founding and early history of the university are Václav Chalopecký, *Karlova universita v Praze, 1348–1409* (Prague, 1948), pp. 32–43; and F. Kavka, *et al., Stručné dějiny university Karlovy* (Prague, 1964), pp, 7–43.

Charles devoted much of his effort to obtaining qualified professors for the school. Some, as John of Moravia, were natives of the crown lands of Bohemia, while others came from foreign centers in Italy and France. By the mid-1350's students were attending classes in the imperial capital from all the states of central Europe, as well as from France, England, and Scandinavia. But despite these successes, the university had no permanent residence; instruction was held in the several churches of Prague. In addition, statutory definition for the school was vague. Not until the 1360's was this provided. By that time the university was sufficiently developed that it could be organized into nations: Bohemian, Polish, Bavarian, and Saxon.

In the Polish nation were, if we may judge from the later decree of Kutna hora,[49] students from the *regnum Poloniae*, Silesia, the lands of the Teutonic Order, Lusatia, and other lands to the east of Bohemia. Before 1364 the names of four from the *regnum* proper have come down to us: Stanisław, a cleric from Włocławek; Mikołaj, the son of a certain Henry of Poznań; Falisław Neusse; and Mateusz of Cracow.[50] Since complete registers and records of matriculations and promotions for the early history of the university are lacking, this is undoubtedly a fragmentary list. It should be noted, however, that none of the Polish names from Prague were in any way connected with the foundation of the University of Cracow. Nevertheless, the example of Charles was not lost upon Casimir.

Despite some efforts shortly after the foundation of Prague, Polish plans for the erection of a *studium generale* were delayed for a period while royal attention was focused upon other affairs of state. It was not until after 1362 that the Polish king was able to initiate negotiations with local Polish officials and the papal curia for the foundation in Cracow of a university "in all legitimate faculties." On 12 May, 1364, Casimir issued a royal charter, establishing the university. In it, he provided for the erection of one chair in liberal arts, two chairs in medicine, three in canon law, and five in civil law. The organization of the university was modeled upon that of Bologna, with the rector being elected from among the students. In addition, students were given the customary privileges provided scholars in the Middle Ages. Four months later, on 1 September, Pope Urban V confirmed the royal foundation after regularizing control of the university and defining the faculties in which instruction was to be offered.[51] I have elsewhere described in detail the circumstances of this foundation.[52] In this present study it is necessary only to emphasize several points about the early character of the Cracow *studium* and to deal with some of the more troublesome aspects of the precarious history of the Casimiran foundation before turning to a detailed discussion of specific areas of learning in late Piast Poland.

The Casimiran foundation in Cracow derived from royal initiative, was designed to further the study of law, and was one of the means by which Casimir hoped to consolidate state (i.e., royal) power and regularize the system of public administration. Throughout all the negotiations which led to the erection of the university, it is clear that the king was the guiding force. It was he who in 1351 had sent one of his most trusted officials, Chancellor Florian Mokrski of Łęczyca, to Italy to investigate university education there.[53] Further it was he who had raised the question of a higher ***studium,*** first with the town officials of his newly founded city of Kazimierz (today a distinct district within Cracow), then with the municipal council of Cracow. They in turn supported him in his request.[54]

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[47] The papal bull is in *Monumenta historica universitatis Pragensis* (3 v., Prague, 1830–1848) **2**: p. 219; the imperial bull, **2**: p. 223.

[48] See the comments of Ferdinand Seibt, in *Handbuch der Geschichte der böhmischen Länder*, edited by Karl Bosl (Stuttgart, 1967 ff.) **1**: pp. 450–452.

[49] The decree itself is available only in a notarial document from 1414. See the edition of G. Friedrich, "Dekret Kutnohorský," *Český Časopis historický* **15** (1909): Supplement. For the decree in relation to the organization of the nations, see F. M. Bartoš, *Karlova universita do dekretu kutnohorského* (Prague, 1939), p. 62; and Ewa Maleczyńska, "Z dziejów interpretacji dekretu kutnohorskiego," *Kwartalnik historyczny* **66** (1959): p. 717.

[50] *M.P.V.* **3**: pp. 413, 330, 457 respectively.

[51] The six documents relating to the founding were first analyzed and edited by Ludwik Krzyżanowski, "Poselstwo Kazimierza Wielkiego do Awinionu i pierwsze uniwersyteckie przywileje," *Rocznik Krakowski* **4** (1900): pp. 1–111. Unless otherwise noted, quotations and paraphrases below relating to the foundation are taken from the Latin text, pp. 55–73.

[52] Knoll, "Casimir the Great and the University of Cracow": also useful are Vetulani, "Les Origines de l'Université de Cracovie," *Acta Poloniae Historica* **13** (1966): pp. 13–40; and Jan Dąbrowski, "Czasy Kazimierza Wielkiego," in: Kazimierz Lepszy. ed., *Dzieje Uniwersytetu Jagiellońskiego w latach 1364–1764* (Cracow, 1964), pp. 15–36.

Casimir was also very explicit in his request to the pope and in his charter of foundation that, whatever other functions the university was to serve, it was to exist especially for the study of law.[55] Thus, although he expressed a willingness to endow only one chair of arts (apparently hoping that others would provide support for additional professors), he guaranteed income from the royal salt works at Wieliczka for all three professors necessary for instruction in canon law and for the five necessary in civil law. This emphasis upon law reflects the pragmatic needs of the kingdom for trained legal administrators.

Although several individuals who had served as royal, provincial, and local administrators during Casimir's reign had legal training,[56] there were too few with the background and expertise necessary to cope with the increasing complexity of Polish governance. With the codification of Polish law (see below) and the elaboration of a truly national administration (as reflected by Janko of Czarnków), the university was to be Casimir's means of meeting the needs of his kingdom. For this reason he attempted to control the governance of the university by designating the chancellor of Cracow (who was a royal appointee) as the supreme administrative officer of the school.[57] Had the university functioned as Casimir envisioned it, there would have been a potential administrative corps which could have made tangible the abstract ideal of royal power within the ***regnum.***[58]

Such an achievement was not to be, however, and the limited impact which the new university had upon the kingdom may be traced to several factors, some of which were foreshadowed by similar earlier developments at Prague. Even before Casimir's death, the original conception for the ***studium*** had been compromised. The failure of the pope to approve the erection of a theological faculty, despite the explicit arguments of the king advocating this, meant that there would be no scholastic forum for the growing Polish expertise in this area of learning.[59] Further, Casimir decided to delay activation of the school until after the death of his arch-enemy Bodzanta, who in his capacity as bishop of Cracow had been designated by the pope in place of the chancellor of Cracow to promote within the institution. This allowed three precious years to pass without opening the university. In addition, the financial base upon which studies were to rest had not been clearly established by 1370.

But the most obvious problem faced by the Casimiran foundation was the inopportune death of its patron. No new Macaenas rose to replace Casimir until Bartholomew of Jasło began to urge Queen Jadwiga to revive the *studium* a generation later.[60] In the interim, the political tribulations which afflicted the Polish state under the rule of Louis of Hungary[61] allowed the attention of political and ecclesiastical leaders alike to be directed away from the university.

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[53] Chancellor Florian's activity in Italy is reflected in the document in Augustine Theiner, ed., *Vetera Monumenta Poloniae et Lithuaniae gentiumque finitimarum historiam illustrantia . . .* (4 v., Rome, 1860–1864) **1**: p. 774. The hypothesis that he was sent to Italy by the king is only implicit in the document. The explicit argument in the text was first developed by Jan Fijałek, *Dominus Bartolus de Saxoferrato et eius permagna apud Polonos auctoritas* (Cracow, 1914), pp. 4 ff., and is now commonly accepted.

[54] See the statement of the municipality in Krzyżanowski, "Poselstwo Kazimierza Wielkiego do Awinionu," p. 65: "Igitus nos . . . civitatis Cracoviensis, serenissimi principis . . . domini Kazimiri . . . illustris pium et saluberrimum desiderii conceptum obedienter. . . ."

[55] ". . . studium generale in quacumque facultate et specialiter tam iuris canonici quam civilis erigere . . ." (p. 55).

[56] Compare the lists provided by Kaczmarczyk, *Monarchia* **1**: pp. 307–314; and **2**: pp. 323–325.

[57] ". . . super illos cancellarius noster Cracoviensis, qui pro tempore fuerit, tamquam suppremus, approbandi huiusmodi examen omnimodam habeat potestatem" (p. 64). This stipulation by the king was not approved by the pope.

[58] See the comments on royal centralization and the growth of an administrative corps in the comparative study by Vladimír Procházka, *Centralizujici se středověká monarchie* (Prague, 1960), pp. 151–153 especially.

[59] This papal denial, repeated later at Vienna and Pécs, arose neither from a desire to preserve Parisian dominance in theology nor from interference by Emperor Charles IV, who might have sought a theological monoply for Prague in east central Europe. Instead, it was purely local considerations (particularly the absence of any native doctors of theology in Poland) which influenced Urban. See Vetulani, "La fondation des universités dans l'Europe Centrale aux temps du pontificat d'Urbain V," *Atti del primo Congresso internazionale della Società Italiana di Storia del Diritto* (Florence, 1966), pp. 361–367, and *Początki najstarszych wszechnic środkowoeuropejskich* (Wrocław, Warsaw, and Cracow, 1970), pp. 94–103.

Despite these problems, the Cracow *studium* was not without some influence. At least seven individuals studied there, four of whom received their bachelor's degree. In addition to the arts faculty, apparently the medical faculty and perhaps the faculty of canon law functioned. The latter would have been most probably associated with the cathedral chapter on Wawel Hill.[62] Finally, the beginnings of the university library may be found in this era, for at least three surviving manuscripts of the *Biblioteka Jagiellońska's* collection are derived from the Casimiran period.[63] These data are the fragmentary remnants of what was, one may reasonably infer, a more substantial achievement; but the vicissitudes of east central European history provide us with no certainty about the university beyond what has already been said. Fortunately, when we turn to the specific areas of learning in this period, it is possible to provide more detail.

III. LAW

Polish law in the early fourteenth century was an inchoate combination of customary law from the several territories of the crown, of previous royal decrees, and of various foreign admixtures. Unlike the practice of canon law[64] or the knowledge of Roman law,[65] native law had generally remained uncodified and unwritten. So long as the kingdom and the monarchy had remained decentralized and relatively undeveloped politically, this legal situation had been adequate. When in the fourteenth century, however, the late Piasts began to reverse the centrifugal forces in Poland, it soon became evident that tradition was inadequate for the governance of the realm.

Casimir's contemporaries were generally loath to accept Roman law as an administrative tool, even those who generally favored the strong centralized monarchy which it so effectively reinforced in the west. There was a profound suspicion in Poland of that law. Polish students in the thirteenth century had studied in sufficient numbers at the law schools of northern Italy so that there was a widespread awareness of the commonly held view that Roman law was imperial law, and they mistrusted the German empire of the Middle Ages and its law.[66] This attitude found particular expression in the so-called *Law of the Poles,* dating from the third quarter of the thirteenth century.

In this fragmentary treatise, probably written by a high Polish ecclesiastic with legal training, the introduction begins with the argument that the Romans conquered a certain country which is called Germany, to which they immediately gave their law. Throughout the long portion which we have extant, there runs the current of opposition to Roman law and all other things German. In describing Polish law, the author emphasizes its origins in the practices of earlier generations and the decrees of native leaders and rulers, and posits its juridical independence from any imperial law. He also utilizes the argument that the Polish state, from the moment of its Christianization, had justified its existence not by reference to the imperial throne and its law but to the papacy, whose immediate suzerainty it recognized.[67]

This attitude of independence and unwillingness to accept the *ius scriptum* of the Empire found clearest expression in late Piast Poland in the figure of Spicymir of Melsztyn, who had been a tutor to King Casimir and castellan of Cracow. Although he was described in the document cited below as *rudis et ignarus,* this is not completely accurate, for he was a man of affairs and had frequently been used by Casimir as a personal representative on diplomatic missions.[68] Sometime prior to 1357, he was sent to the court of Emperor Charles IV. There, in a discussion about imperial authority, he argued that "your Emperor is a subordinant of the pope, having taken an oath to him; our king holds his crown and sword directly from God, and his laws and customs take precedence over the laws of the Empire." [69]

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[60] Maria Kowalczyk, "Odnowienie Uniwersytetu Krakowskiego w świetle mów Bartłomieja z Jasła." *Małopolskie Studia Historyczne* **6**, 3–4 (1964) : pp. 23–42.

[61] Janko of Czarnków's bitter comment was that "Hujus autem regis tempore nulla stabilitas, nulla justitia in regno Poloniae habebatur," *M.P.H.* **2**: p. 721.

[62] Vetulani, "U progu działalności krakowskiego Wydziału Prawa," in: *Studia z dziejów Wydziału Prawa Uniwersytetu Jagiellońskiego,* edited by Michał Patkaniowski (Cracow, 1964), p. 33, has softened considerably the specific assertions made by Fijałek, "O początkach i znaczeniu Uniwersytetu Krakowskiego w XIV i XV wieku," in *Księga pamiątkowa Uniwersytetu Lwowsiego ku uczczeniu pięćsetnej rocznicy fundacyi jagiellońskiej Uniwersytetu Krakowskiego* (Lwów, 1900), p. 5.

[63] For a detailed description, see Jerzy Zathey, *et al., Historia Biblioteki Jagiellońskiej* **1**: *1364–1775* (Cracow, 1966) : pp. 2–21.

[64] See Vetulani, "La pénétration du droit des Décrétales dan l'Église Polonaise au XIIIe siècle," in: *Acta congressus iuridici internationalis VII saeculo a Decretalibus Gregorii IX et XIV a Codice Justiniano promulgatis* (Rome, 1936) **3**: pp. 385 ff.

[65] See particularly Rafał Taubenschlag, *La storia della recenzione del diritto romano in Polonia* (Bologna, 1939).

[66] This identification of Roman with imperial law is discussed by Stefan Gagner, *Studien zur Ideengeschichte der Gesetzgebung* (Stockholm, 1960), pp. 307–335.

[67] The extant fragments are printed together with a translation into modern Polish by Józef Matuszewski, *Najstarszy zwód prawa polskiego* (Warsaw, 1959). This should be supplemented with Vetulani, "Niemiecki spis polskiego prawa zwyczajowego," *Czasopismo Prawno historyczne* **5** (1953): pp. 183–186.

Another alternative to the utilization of Polish law in the administration of the *regnum* was the already widespread observance of Germanic law in Poland. Originally extended to German settlements east of the Oder, this law, particularly in its Magdeburg version, was eventually extended to municipalities without regard to the origin of their population. Thus, especially in the early years of his reign, Casimir depended heavily upon Germanic law. Of the more than 500 towns he founded, 102 were granted charters under Magdeburg law. Of the many individual privileges he bestowed, most from the first two decades of his region took the form of a grant *de jure theutonico.*[70]

To preserve royal prerogatives, however, it was important to the last Piast that legal disputes under German law not be appealed beyond the *regnum.* At royal initiative therefore there was established in 1356 a Supreme Court of German Law at the royal castle in Cracow.[71] Here under officials trained in German law, all issues of dispute from the province of Little Poland were to be adjudicated. But this court was never completely effective in halting appeals to Magdeburg, nor was it able to extend its competency to the whole of the kingdom. It remained as only one part of the practice of law in this period.

Even before Casimir had attempted to regularize German law, he had begun, despite the Polish hesitancy to accept the idea of *ius scriptum* as a basis for judicial practice, to consider the possibility of codifying Polish law and establishing it as the instrument by which the kingdom would be ruled. His reasons were clear enough, and in the *Prologus* to the *Statuta Casimiri Magni,* which eventually emerged from the efforts of the codifiers, Casimir argued that there had been no previous judicial uniformity in the kingdom, that diverse spirits had judged one and the same matter in different ways, and that because of these variations many problems had arisen in the kingdom. He concluded that some single, systematic approach to law was necessary and desirable.[72]

In order to give form and expression to Polish law, Casimir turned instinctively to Jarosław Bogoria, his former tutor and, since 1342, archbishop of Gniezno.[73] This churchman was a member of one of the most distinguished families of Little Poland, the Skotnicki, and had studied theology in Italy and law at Bologna from 1316 to 1322. Thereafter his rise had been rapid. As canon of Cracow, he served also as chancellor of Bishop Nanker, then (1326) archdeacon of Cracow and shortly thereafterward canon of Gniezno. His close ties to Casimir and his abilities had caused him to be named royal prosecutor in a papal suit against the Teutonic Knights in 1339. His success there and the death of the incumbent archbishop enabled Casimir to have him appointed as the new Polish primate. Throughout the remainder of the king's reign, Jarosław was one of his closest advisers, and in the codification of Polish law it was his legal and administrative skills which brought the project to completion.

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[68] F. Piekosiński, *Rycerstwo polskie wieków średnich* (3 v., Cracow, 1896–1902) **3**: p. 502.

[69] The text is printed by Jan Dąbrowski, *Ostatnie lata Ludwika Wielkiego 1370–1382* (Cracow, 1918), p. 3, n. 1.

[70] For examples of Casimir's use of German law, see the discussion in Kaczmarczyk, *Polska czasów Kazimierza Wielkiego* (Cracow, 1964), pp. 83–85, 114–117.

[71] Piekosiński, "Przywilej króla Kazimierza Wielkiego w przedmiocie założenia sąda wyższego prawa niemieckiego na zamku krakowskim," *Rozprawy Akademii Umiejętności, wydział historyczno-filozoficzny* **35** (1898): pp. 290–306, particularly the wording of the decree on p. 301: "dicti contendentes ad partes remotas Rynenses Maydburg civitatem, cui nullo iure subsunt, et ultra fines regni nostri appelaciones et provocaciones interponunt, nostre maiestatis proprio solio et tribunali necnon proprii principis et domini iure et iurisdictione obmissis et contemptis, et in detrimentum regni nostri, dampnum et regnicolarum nostrorum gravamen . . ."

[72] *Polskie Statuty Ziemskie w redakcji najstarszych druków,* edited by Ludwik Łysiak and Stanisław Roman (Wrocław and Cracow, 1958), p. 63: "Prologus." Citations to the Statutes of Casimir the Great will be to this edition, with parenthetical reference to (1) the sections of the Królewiec manuscript from which the earliest printed editions were derived and which is printed in *Archiwum Komisji Prawniczej Polskiej Akademii Umiejętności* [hereafter cited as *Arch. Kom. Praw.*] **2** (1895): pp. 1–53; and (2) the sections of the statutes as printed in *Starodawne Prawa Polskie Pomniki,* edited by Antoni Zygmunt Helcel, **1** (Warsaw and Cracow, 1856).

[73] His central role in the codification is attested to in the prologue to the statutes for Greater Poland. See *Arch. Kom. Praw.* **2**: p. 27.

Unfortunately when we seek to determine the mechanics and the details by which this was accomplished, our sources are silent. Janko of Czarnków, later royal vice-chancellor, who may have participated in the codification,[74] remarks in his chronicle only that in Poland from ancient times the law had been variously administered and that much injustice and injury had resulted from this condition. To remedy this, according to him, Casimir, "zealous in his inclination for justice," convened the prelates, nobles, and barons of the whole realm to work out a unified written law code which would be observed for all time.[75] It is even difficult for us to determine with certainty when the statutes were issued. Ostensibly the work of codification was completed by the 1340's, and a unified code was issued to the territory of Little Poland at a convocation (*colloquium*, Polish *wiec*) in Wiślica in 1346, while the same code was presented to Greater Poland at Piotrków later the same year. But the careful investigations of Polish legal historians have revealed that the matter is more complex than this; at the same time the work of these scholars has shed inferential light upon the nature and significance of Casimir's codification.[76]

Legal materials relating to little Poland were gathered by Archbishop Jarosław over a period of two or three years. Then with the advice of the barons of the region, some twenty-six articles were issued at Wiślica in 1346. These included, among others, materials relating to the choosing of judges, appropriate titles, the rights of peasants, the responsibilities of knights, punishments and fines for certain civil crimes, regulations governing testimony, property rights for women, the laws of inheritance, accusations of murder, and similar regulations.[77] Later that same year, probably in July, at a *colloquium* in Piotrków in Greater Poland, another set of articles was issued. This too had been prepared by Jarosław in consultation with the local barons, and it covered many of the same topics as the articles of Wiślica. But in these thirty-four articles from Greater Poland, there are some individual regulations not previously issued as well as some points which are at variance with the Little Poland statutes.[78] For example, there are included articles relating to who may be summoned before the *curia regis* or any other court, what interest may be charged by Jewish moneylenders, the rights of daughters given in marriage, and the establishment of salaries for judicial officials.

In order to supplement these two basic collections, there were additional articles issued from time to time thereafter. Prior to 1359 Little Poland was provided with statutes relating to German law, to outdated and superseded regulations, to Jews, to penal definitions, and to the mining of salt;[79] it was also given a group of articles now called collectively *Extravagantes*.[80] For Greater Poland there were also supplemental decrees issued.[81] Finally, to complete the legal *corpus,* some few statutes were issued which were explicitly applied to the whole of the *regnum.*[82]

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[74] According to Józef Sieradzki, *Polska wieku XIV* (Warsaw, 1959), p. 59.

[75] *M.P.H.* **2**: p. 624.

[76] The description and analysis which follow correspond to the general conclusions reached by Kaczmarczyk, *Monarchia* **1**: pp. 45–96, particularly in matters of dating. It should be noted, however, that in his more popular work, *Polska czasów Kazimierza*, pp. 89–93, Kaczmarczyk provides a simplified version which is at some variance with his earlier study. The sharpest critic of his dating has been Roman, *Geneza Statutów Kazimierza Wielkiego, Studium Źródłoznawcze* (Cracow, 1961), who dates the codification from the 1350's. See pp. 209–212 for a summary of his views.

[77] The original articles promulgated at Wiślica are the following articles from the complete code in *Polskie Statuty Ziemskie* (together with alternative citations): 1 (1,1), 11 (11,11), 12 (12,12), 13 (13,13), 13–14 (14,13), 16 (16,15), 17 (17,16), 18 (18,17), 19 (19,18), 20 (20,19), 24 (24,23), 25 (25,24), 26 (26,25), 28 (28,27), 29 (29,29), 37 (36,36), 39–42 (38,38–41), 47 (43,46). 48 (44,47), 54 (50,53), 56 (52,55), 57 (53,56), 58–59 (54,57–58), 63 (56,60), 64 (57,61), 65–67 (58,62–63).

[78] The Piotrków articles were the following: 17 (115, 142), 18 (132,17), 19 (111,18), 83 (131,153), 115 (118. 114–115), 117 (119–116), 118 (119,117), 120 (124,149), 124 (125,124), 125 (128,126), 126 (129,127), 127 (134. 132), 128 (135,129), 129 (136,130), 130 (136,131). 131 (137,132), 132 (140,133), 135a (141,134), 135b (109,137), 136 (110,138), 137 (114,141), 139 (120–121,145–146), 141 (122,147), 142 (123,148), 144 (117,144), 145 (130. 152), 146 (133,154), 147 (112,139), 148 (113,140), 151 (138,153). Articles issued at Piotrków, but not printed in the earliest legal codes edited by Łysiak and Roman, include the following from the Królewiec manuscript: 108 (136), 116 (143), 126 (150), and 139 (156).

[79] *Polskie Statuty Ziemskie,* 66 (59,64), 68 (60,65), p. 141, no. 2 (61,66), 69 (62,67), 102–104 (102–104,100–102), 71–72 (64–65,69–70), 83 (76–77,81), 84–88 (78–82,82–87), 61 (83,88), and 101 (101,99).

[80] *Polskie Statuty Ziemskie*, 6–8 (6–8,6–8), 15 (15,14), 21–23 (21–23,20–21), 27 (27,26), 70 (63,68), 84 (100, 106), 89–99 (84–91,89–97), 103–104 (95–96,101–102), 107 (100,106).

Although Casimir had originally hoped to establish one law for the whole kingdom, it is apparent from the foregoing that he did not. It was only after his death and during the first generations of the Jagiellonian dynasty that the *Statuta Casimiri Magni* became the core of general Polish law. In form, the statutes betray certain foreign influences upon them, particularly Czech and to a lesser extent German and Roman. Their substance was, however, wholly Polish.[83] Until the partitions of the eighteenth century, this code served the original vision of its initiator, uniting the state, ordering the lives of its subjects, and defining the processes by which royal government functioned. Ironically, despite the last Piast's hope that the university he founded would serve an important function during the final years of late Piast Poland, the Cracow *studium* exercised virtually no influence upon the Polish legal and administrative system. As Adam Vetulani has pointed out, "we do not know the name of any student [in law] at the university, and neither have we to this point been successful in identifying any legal manuscript connected with the university from this period." [84]

IV. VERNACULAR AND LATIN LITERATURE

Compared to its very substantial achievement in law, the late Piast period produced relatively little in the area of literary monuments, whether in Latin or in the vernacular. As might be expected, most of these are ecclesiastical in nature, derived either from the Bible directly or from some religious theme in the Christian heritage.

Of the former group, the most notable were the Psalter of St. Kinga and the Florian Psalter. The first, unfortunately no longer extant, dated from the later part of the thirteenth century. Its existence is established by a notice in the anonymous life of St. Kinga (Cunegunda), the Cracow princess who became a Clarisian nun in Stary Sącz.[85] The Psalter itself apparently contained Polish translations of some of the Psalms, although it may have been the intention of those who prepared it to provide a complete translation. The Florian Psalter, so-called from its centuries-long possession by the Lateran canons of St. Florian near Linz, Austria, is a complete edition of the Psalms in Latin, Polish, and German. The Polish portions of the 296-page folio volume apparently derived from the earlier Kinga Psalter. Although it may have been prepared in Silesia, which would account partially for the use of the two vernaculars, the Psalter was destined for the use of Queen Jadwiga.[86]

One of the most important collections of religious literature in the vernacular from late Piast Poland is a series of sermons associated with the monastery of the Holy Cross near Kielce in Little Poland. Although scholars have disagreed about the dates which should be assigned to the one complete and five fragmentary sermons, it is now customary to assign them to the late thirteenth or early fourteenth century.[87] The extant sermons, which probably represent a part only of what was originally a larger collection, treat the question of angels (in conjunction with the feast of St. Michael), the life of St. Nicholas, the feast of St. Catherine, the Nativity, Epiphany, and the Feast of the Purification.[88]

In the category of hymnology, there are three examples in the vernacular which date from this period. The most famous is the *Bogurodzica,* or *Hymn to the Virgin,* an earlier composition which took final form in this period.[89] This celebration of the glory of Mary and her position as Mother of God[90] was later sung by victorious Polish soldiers at the battle of Grunwald in 1410 and became a symbol of nascent Polish nationalism. The Easter hymn *Chrystus zmartwych wstał je . . .* is first noted in the aforementioned 1365 Gradual from Płock. Though derived ultimately from the third stanza of the Latin hymn *Deus omnipotens,* the translation is apparently based upon older Czech and German sources.[91] Finally, the Christmas carol from the mid-fourteenth century, *Posłał przez anioły . . . ,* was a popular translation of Peter Abelard's *Mittet ad Virginem.*[92]

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[81] *Polskie Statuty Ziemskie,* 32 (152,163), p. 141, no. 1 (153,166).

[82] See Kaczmarczyk, *Monarchia* 1: Dodatek I, p. 291: D,E,G.

[83] The dean of Polish legal historians, Oswald Balzer, began an intensive study of the statutes of Casimir the Great and their inspiration. His work was completed posthumously in *Statuty Kazimierza Wielkiego,* edited by Zdzisław Kaczmarczyk, Michał Sczaniecki, and Stefan Weymann (Poznań, 1947). See also Balzer's article, "Maiestas Carolina i inne źródła prawa czeskiego z w. XIV a Statuty Kazimierza Wielkiego," *Kwartalnik Historyczny* 33 (1919): pp. 221 ff.

[84] Vetulani, "U progu działalności," p. 33.

[85] *Nowy Korbut: Bibliografia Literatury Polskiej* (Warsaw, 1963 ff.) 1: p. 178: ". . . ex intentione propriae industriae consuetudo sibi merat, quod decem psalmos in vulgari antequam ecclesia exiret, Deo persolvebat . . . et sic totum psalterium per ordinem complebat. . . ."

[86] See Ludwik Biernacki, ed., *Psałterz florianski, lacinsko-polsko-niemiecki, Rękopis Biblioteki Narodowej w Warszawie* (Lwów, 1939).

[87] *Nowy Korbut* 1: p. 240.

[88] The sermons were discovered, edited, and discussed in detail by Aleksander Brückner, "Kazanie świętokrzyskie," *Prace Filologiczne* 3 (1891): pp. 697–707, 708–722 (text), 723–740.

[89] The enormous literature connected with this hymn is discussed in detail and a critical edition of the several manuscript traditions is provided in the handsome volume by Jerzy Woronczak, ed., *Bogurodzica* (Wrocław, Warsaw, and Cracow, 1962), pp. 7–25 particularly.

In the area of religious drama, there was one theme which often received treatment in Latin and which may be counted among the literary achievements of late Piast Poland. This was the *Visitatio sepulchri,* of which several versions are extant. One dates from the second half of the thirteenth century and is connected with Cracow; a second, from the first half of the fourteenth century, derived from Cracow, but connected with Silesian centers; and a third, independent Cracovian version from about 1370.[93] These short dramas, which were closely connected with the Easter liturgy, were introduced into Poland from the west and became particularly popular in the thirteenth and fourteenth centuries. Based upon the text of the four gospels, they presented the three Marys, pursued by several disciples, as they approached the tomb of the risen Christ. The versions available to us today reflect the deepening of the spirit of lay piety in this period, while at the same time they provide occasional insertions in the vernacular which are of importance in tracing the history of the Polish language.

Not all the literature of the period was ecclesiastical. Among the limited examples of secular literature, two in particular plus some scattered verses and death notices deserve mention. The first work is the *Carmen Mauri,* which in its original form was a versified treatment of the life and activity of Piotr Włostowic (Peter Włast). It described in some 300 to 400 hexameters[94] the role which he played in twelfth-century Poland, particularly his opposition to King Władysław II, son of Bolesław the Wrymouth. Although some scholars have tried to assign this composition to the late twelfth century,[95] it dates more probably from the late thirteenth century,[96] and is connected with a Silesian Benedictine named Maurus in the monastery of St. Vincent in Wrocław. All that remains today are fragments which have been interpolated into the *Chronicon Polono Silesiacum* (see below for this chronicle).[97] These isolated verses are sufficient, however, to reveal the author as a poet of considerable talent.

The second example of secular literature is the 126 Leonine verses in 21 stanzas which constitute the poem *De quodam advocate Cracoviensi Alberto* (early fourteenth century, *post* 1311).[98] Albert had been the civil administrator of Cracow under Duke Władysław Łokietek and had led an unsuccessful revolt against Piast leadership in conjunction with the bishop of Cracow, Jan Muskata. The orientation of this uprising was anti-Polish and pro-German, in both a cultural and a political sense, and it had been repressed with great severity. The poem itself, from the hand of an anonymous Pole whose Germanophobia prevades the text, is cast in the form of a posthumous confession by an Albert conjured from the grave. Its worth as a historical source is clearly limited, but as a literary endeavor it is a clever piece of satire and political propaganda.

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[90] This tradition of Mary as "Theotokos" connects this hymn to Byzantine liturgical traditions, perhaps through the earlier missions of SS. Cyril and Methodius. See M. Weingart, "Z nové literatury o otázkách cyrillo-methoděských," *Byzantinoslavica* **6** (1937): p. 335.

[91] The text in Bersohn, *Księgozbiór katedry płockiej,* p. 22.

[92] See Brückner, *Średniowieczna pieśń religijna polska* (Cracow, 1923), pp. 128–129.

[93] Manuscripts of the three respective traditions are best represented by the following: Cracow, Archiwum Kapituły MS 83; Wrocław, Biblioteka Uniwersytecka MS Br. Mus. K21; and Kielce, Archiwum Kapituły MS 79. These unedited liturgical offices are briefly discussed by Stanisław Windakiewicz, "Dramat liturgiczny w Polsce średniowiecznej," *Rozprawy Akademii Umiejętności, wydział filologiczny* **34** (1902): pp. 340–356.

[94] According to M. Plezia, ed., *Cronica Petri comitis Poloniae wraz z tzw. Carmen Mauri,* in *M.P.H., nova series* [hereafter cited as *M.P.H., n.s.*] (ten volumes to date, Warsaw, 1946 ff.) **3**: p. xiii. Brygyda Kürbisówna, in a review of this edition in *Studia Źródłoznawcze* **1** (1957): p. 214, has, however, argued this is instead Leonine verse.

[95] In addition to Plezia, see also Aleksander Semkowicz, in his introduction to an earlier edition of the *Kronika o Piotrze Właście,* in *M.P.H.* **3**: pp. 745–761.

[96] See particularly Ryszard Gansiniec, "Średniowieczne poematy o Piotrze Włostowiczu," *Sprawozdanie Polskiej Akademii Umiejętności za rok 1951,* no. 8.

[97] In *M.P.H.* **3**: pp. 765, 784.

[98] The text printed by Edmund Długopolski, "Bunt Wójta Alberta," *Rocznik Krakowski* **7** (1905): pp. 184–186.

Finally, there are some miscellaneous items. In the *annales* of Kujavia, which derive from the second half of the fourteenth century, there is interpolated a six-verse poem written by an anonymous cleric from Wrocław celebrating the Polish victory over the Teutonic Knights at Płowce in 1331.[99] These verses were apparently composed by an eyewitness immediately after the battle. Among other compositions from this period are four Leonine verses on the death of Duke Leszek of Kujavia (d. 1298),[100] forty-nine hexameters from the first quarter of the fourteenth century on the founding of the Cistercian monastery in Lubiąż,[101] and the short epitaphs of Piotr Włostowic and Duke Świętopełk of Pomorze,[102]

In sum then, the literary achievement of late Piast Poland was a modest one. The one exception to this conclusion is in the area of historical writing, both hagiography and narrative history, where there was both a vital tradition and significant achievement. Four saints' lives and five historical narratives of varying quality derive from this period, as well as numerous *annales* (*Roczniki*) which we shall not treat here.

V. HISTORICAL WRITING

The *Miracula sancti Adalberti* is the earliest saint's life from this period and represents the culmination of a tradition dating to the early eleventh century. By the second half of the thirteenth century, there already existed several lives of St. Adalbert, the Czech missionary in Prussia who was martyred in 997 and for a time buried in the Polish metropolitan see of Gniezno.[103] Sometime in the course of the last third of the thirteenth century (*ante* 1295), an anonymous author (perhaps in Trzemeszno near Gniezno) prepared a continuation of earlier works on the deeds of the martyr. The focus of this treatise is upon the miracles attributed to Adalbert, and for this the author depends largely upon the *Vita maior sancti Stanislai* and the *Legenda de sancto Adalberta episcopo*. It is a work which adds little to our understanding of one of Poland's two patron saints.[104]

Of much more importance is the *Vita Sanctae Hedvigis,* which describes the life and miracles of the Silesian princess who was the wife of Duke Henry the Bearded.[105] The *vita* itself is divided into several different parts, including a *legenda maior* and *minor,* a genealogical treatise and a set of tables, and the text of the bull of canonization in 1267. The biographical sections were probably completed late in the thirteenth century, certainly before 1300,[106] and are an invaluable source for the social history of the period. As a literary achievement, this work from an anonymous Franciscan ("ego pauper et modicus, collegio pauperum aggregatus . . .") compares favorably with the hagiographical tradition in western Europe. If less original than some, it is nevertheless stylistically an equal.

The *Vita et miracula sanctate Kingae* has already been mentioned in another context. It too contains a priceless miscellany of Polish customs and social practice from the late thirteenth and early fourteenth centuries. It is, however, inferior in literary merit to the life of St. Jadwiga.[107] These same characterizations and judgments apply equally to the *Vita sanctae Salomeae,* a work dating from at least 1287/92 and perhaps as late as the mid-fourteenth century. It describes briefly the life and miracles of the Polish princess who became queen of Galicia and Hungary. She was a particular patron of the Clarisian order, and the *vita* comes probably from the pen of a Franciscan.[108]

In the realm of historical narrative, the late Piast period is marked at its beginning by a major historiographical achievement, the *Chronicle of*

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[99] In *M.P.H.* **3**: p. 210. (See also an eight verse version in *M.P.H.* **5**: p. 906.)

[100] *M.P.H.* **3**: p. 77.

[101] *M.P.H.* **3**: pp. 708–710.

[102] *M.P.H., n.s.* **3**: p. lx; and M.P.H. **6**: pp. 352 and 354 f. respectively.

[103] The most important of these are discussed by Jadwiga Karwasińska, "Studia krytyczne nad żywotami św. Wojciecha, biskupa praskiego," *Studia Źródłoznawcze* **2** (1958): pp. 41–79; and **4** (1959): pp. 9–32.

[104] The text of the *Miracula* has often been printed, but the best edition pending the completion of Jadwiga Karwasińska's work is by W. Kętrzyński in *M.P.H.* **4**: pp. 226–238.

[105] Text in *M.P.H.* **4**: pp. 510–651, ed. A. Semkowicz. For a critical analysis of the sources for Jadwiga's *Vita,* see the excellent recent biography by Joseph Gottschalk, *St. Hedwig Herzogin von Schlesien* (Cologne and Graz, 1964).

[106] See Jan Dąbrowski, *Dawne dziejopisarstwo Polskie (do roku 1480)* (Wrocław, Warsaw, and Cracow, 1964), p. 93.

[107] The text of the *Vita* is in *M.P.H.* **4**: pp. 682–744, ed. Kętrzyński. The work dates from probably 1317 to 1329.

[108] The text in *M.P.H.* **4**: pp. 776–796, ed., Kętrzyński.

Greater Poland (*Chronica Poloniae Maioris* [*Kronika Wielkopolska*] or *Chronica longa* [*magna*] *Lechitarum et Polonorum*). The narrative of this work treats the history of the Poles from legendary times until it breaks off abruptly in 1272/73, either unfinished or extant only in an incomplete form. This chronicle has absorbed the attentions of many Polish historiographers for the past century and more; but it is only recently that a critically established text and widely accepted interpretation of the many difficulties connected with it has emerged.[109]

Two kinds of problems have generally concerned scholars. One is the question of the sources and development of the chronicle; the other, that of its authorship. For most of the material up through the twelfth century, the author is heavily dependent upon the *Chronica Polonorum* of Vincent Kadłubek (d 1223). Thereafter material has been gathered from a variety of sources, some of them derived from miscellaneous Cracovian *annales*. One important thirteenth-century source in particular is referred to in the text itself. This is the no-longer extant *Annales Polonorum* [*historiae*].[110]. Finally, the chronicler investigated thoroughly and utilized the individual chapter yearbooks of Gniezno and Poznań. One last category of material is included in the final version of the chronicle, but this deserves treatment below in connection with the question of authorship.

Many attributions have been made in this regard, but it is apparent now from the critical text that the fundamental task of compilation and new narrative was undertaken by Godisław Baszko (Godislaus Bartholomaeus) from Poznań.[111] Unfortunately we know little of the life and career of this ecclesiastic. He is first observed in 1252 in the treasury of the bishop of Poznań as a secretary. From 1256 until 1269 (or 1279) he was curator of the cathedral chapter, and from 1278 probably until his death he was its chanter. In 1265 he was sent to Rome to represent the interests of the chapter in the question of a successor to Bishop Bogufał II. During this latter period he produced the *Chronica Poloniae Maioris.* From his text, we can infer his sophisticated understanding of both rhetoric and canon law, but we know nothing of his schooling. His firm support of the Duke of Greater Poland is clearly expressed in the chronicle, and some have suggested that the assassination of the duke the year after his coronation in 1295 may have interrupted the writing of the chronicle. The exact date of Baszko's death is unknown, but it came sometime prior to 1297/98.[112]

Not all of the material in the chronicle comes from Godisław Baszko. In the fourteenth century, a later editor added a great deal of mythological material relating to the origin of the Slavs. The historical accuracy of these data is, of course, negligible, but their inclusion does suggest something about the mentality of that later period as it tried to relate its glories to the achievements of antiquity. Some scholars have attempted to attribute this interpolation and later redaction to Janko of Czarnków, who also wrote an important chronicle in the late Piast period.[113] Their efforts have not been convincing, however, and the final hand in the *Chronica Poloniae Maioris* remains an anonymous one.

From a literary standpoint the chronicle ranks very high. The work corresponds to the best examples of medieval rhetoric, making frequent use of aliteration, of reciprocally reinforcing phrases, and of the grandiloquent style of Vincent Kadłubek. Baszko also includes several poetic insertions, apparently from his own hand. There are in addition many prose sections which have internal rhymes suggesting Leonine verse.[114] From a historical standpoint, this chronicle is equally a significant achievement. Though fiercely partisan to the heritage of Greater Poland's position of leadership in the *regnum* and presenting the events which subsequently lead to the royal coronation of Duke Przemysł II in 1295 as if they reflected the true Polish tradition, Baszko provides data which are accurate and reliable. Moreover, he presents forcibly the ideal of a unified kingdom and of strong royal leadership which was to be more fully realized with King Casimir. Finally, he was systematic and critical in his utilization of sources, and the result is a narrative of high value.

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[109] The nineteenth-century text in *M.P.H.* **2**: pp. 467–598, ed. W. A. Maciejowski, with Introduction, pp. 454–466 by August Bielowski, has now been superseded by an excellent edition by B. Kürbisówna, in *M.P.H., n.s.* **8**, 2 (Warsaw, 1970). See particularly her introduction, pp. v-xxvii and her two earlier studies *Dziejopisarstwo Wielkopolskie XIII i XIV wieku* (Warsaw, 1959), pp. 90–224, and *Studia nad Kronika Wielkopolska* (Poznań, 1952). There are very useful historiographical summaries in each of these works.

[110] ". . . prout ex historicis annalibus Polonorum . . .," (*M.P.H., n.s.* **8**: p. 4); "Zemomisl . . . prout annales Polonorum narrant historiae . . . successit . . ." p. 16); "Cui Cracovite et Sandomirite fortissime resistebant . . . prout in annalibus historiis continetur . . ." (p. 83). The possible existence of this source was first discussed by M. S. Warmski, *Die grosspolnische Chronik* (Cracow, 1879), and S. Smolka, *Polnische Annalen bis zum Anfange des 14. Jahrhunderts* (Lwów, 1873).

[111] "Quod cilicium ego custos Poznaniensis post mortem ipsius vidi ferre quendam sacerdotum." (*M.P.H., n.s.* **8**: p. 108); "Canonici . . . miserunt me Godislaum custodem eiusdem ecclesie Basconem cognomine cum litteris domini episcopi Wratislaviensis ad curiam" (p. 120). See the discussion by Kürbisówna in her edition, pp. xxii-xxvii.

[112] For data on his death, see Kazimierz Jasiński, "W kwestii autorstwa Kroniki Wielkopolskiej," *Studia Źródloznawcze* **1** (1957): p. 229, who argues for a date between 1280 and 1287, i.e., before King Przemysł's death. The dates 1297/98 are given by *Nowy Korbut* **1**: p. 246.

[113] Particularly Dąbrowski, *Dawne dziejopisarstwo Polskie,* pp. 133–139; and Sieradzki, "Sprawa Janka z Czarnkowa i jego utwór," *Studia Źródloznawcze* **4** (1959): pp. 33–53, p. 49 particularly.

It is not possible to be so favorable in judging three other histories from this period. The *Chronicon Polonorum* (or *Chronicon Polono-Silesiacum*) was composed at the turn of the thirteenth and fourteenth centuries by an anonymous Silesian author.[115] Dealing chiefly with Silesian affairs, this chronicle depends heavily upon Kadłubek and the *Carmen Mauri*. It is a useful historical source, but it is annalistic and pedestrian in its narrative. The so-called *Chronicle of Dzierzwa* (*Mierzwa*) is a clumsy compilation of Kadłubek and several *annales* from Little Poland.[116] It also is dependent upon the same long-vanished *Annales Polonorum* utilized by Godisław Baszko. Assembled in the fourteenth century, this work adds no new material to its own sources in its treatment of Polish history from the beginnings to about 1288. It is chiefly useful for reflecting the view that it was the province of Little Poland which represented the royal Piast tradition in the welter of events in the thirteenth century. A Silesian view is provided in the *Chronica principum Poloniae* (*Kronika Książąt polskich*) which treats the history of the Silesian duchies and the bishops of Wrocław to *ca.* 1370.[117] Its early parts are derived from other sources, but it is independent and particularly full for the fourteenth century. Perhaps written by canon Peter of Byczyna (d. 1388 or 1389), this is a work of no great literary merit, but it is historiographically important for two reasons: first, for its detailed treatment of a region which was passing in the fourteenth century from Polish to Bohemian political control and whose cultural character was in transition to a German-Slavic mixture; and second, for its relatively sophisticated use of independent documents and verbal testimony to illustrate its narrative. One of the themes reflected in this chronicle is the persistence of Polish royal interests in Silesia throughout the century.

At the end of the Piast era, Janko of Czarnków composed his chronicle. It ranks with the works of the earlier Gallus Anonymous and Vincent Kadłubek and the later Johannes Długosz as one of the four great literary and historiographical monuments of medieval Poland. Born about 1320, Janko came from one of the lesser landed families of Greater Poland. It is quite possible that he received some of his education in Italy, for he was characterized by his contemporaries as *iuris peritus*, suggesting law studies. His early career was with Bishop Andrew of Schwerin, and during the 1350's we see him as a canon in Butzów in Mecklenburg and later as chancellor of the bishop. During Andrew's absence from the see in 1355, Janko acted as his vicar general. In the service of his bishop to Avigon that same year, Janko made contact with Albert of Bochnia, chancellor of King Casimir of Poland.

This meeting marked the beginning of Janko's growing affiliation with the *regnum Poloniae* and with Casimir. He subsequently accepted a canonry in Włocławek and was eventually sent to Avignon again, this time by the bishops of Poland to represent their interests. His contacts there with Polish officials, including the royal vice-chancellor Jan of Busek and the delegation from Cracow which requested papal approval for the erection of a *studium generale*,[118] cemented his ties to

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[114] See the discussion of Baszko's style by Kürbisówna in the introduction to her edition. pp. xviii-xxii.

[115] Text in *M.P.H.* **3**: pp. 578–656, ed. Ludwik Ćwikliński.

[116] Text in *M.P.H.* **2**: pp. 145–190, 283–438, ed. A. Bielowski.

[117] Text in *M.P.H.* **3**: pp. 423–578, ed. Zygmunt Węclewski. This edition should be supplemented by the extended analyses of both text and contents by Wilhelm Schulte, *Die Politische Tendenz der Cronica Principum Polonie* (Wrocław. 1906), and "Zur Cronica principum Polonie," *Zeitschrift der Verein für Geschichte Schlesiens* **42** (1908): pp. 323–330.

[118] Janko's role in obtaining papal authorization for the erection continues to be controversial. Compare Krzyżanowski, "Poselstwo Kazimierza Wielkiego," pp. 13–17, 34; and Knoll, "Casimir the Great and the University of Cracow," p. 241, n. 46.

Casimir. Shortly thereafter he was named as vice-chancellor of Cracow. This position was in reality a national rather than a regional or local one, and as noted above, Janko was the prime representative of the emergence in late Piast Poland of effective royal governance throughout the whole kingdom.

The height of Janko's career came in 1368 when, in addition to his royal administrative position, he was named archdeacon of Gniezno. The death of Casimir two years later, however, radically altered his status, for Janko was one of a group of magnates from Greater Poland who opposed the succession of King Louis of Hungary in Poland. His involvement in the political intrigues of 1371 and 1372 caused him to lose all his positions, and on 10 April, 1372, he was forced to leave the country in exile. Not for two years was he able to return, and then only to play a very minor role in the cathedral chapter of Gniezno and in Poznań. Most of his time was spent in writing a history of his own times. He died sometime in late 1386 or early 1387.

The *Chronica Polonorum* of Janko of Czarnków,[119] which treats Polish history from 1333 into the 1380's is suffused with admiration of and praise for Casimir on the one hand and inveterate hostility for Louis of Hungary on the other. This political cast to the chronicle does not, however, obscure its significant literary and historiographical achievement. It is organized around specific themes and developments and makes no attempt to adhere rigidly to an annalistic framework. Instead, Janko ranges freely through the decades to discuss, for example, the power of King Casimir and the glory of his kingdom. In fact, his central concern is to celebrate the strength of the Polish monarchy in the fourteenth century by lamenting its fate under Louis. Janko also makes effective use of those documents and details to which he had had access by virtue of his position.

In form the chronicle is divided into several distinct parts. The first substantial segment (sections 4–17) constitutes a detailed chronological treatment of the death of Casimir the Great and the coming of Louis of Hungary to Poland to the fall of 1371. In these events, Janko was frequently an eyewitness, often a participant. For the period 1372 to 1380 (sections 18–45), the treatment is less rigidly chronological. Internal evidence suggests that Janko prepared treatments on individual topics at various times for these years, then reworked them later into an organic whole. In the portion of the chronicle dealing with the last two years of Louis's reign (sections 46–61), the structure is again basically chronological. There is also a more personal side to Janko revealed in these pages as he details triumphantly the death of his own arch-enemies, Bishop Zawiszy of Kurozwęk and Nicholas of Kórnik. This part is followed by a discussion of the claims of Jadwiga to the Polish throne. These and the constitutional problems connected therewith consitute the long final portion of the chronicle (sections 62–116). The chronicle ends on the eve of the accession of Jadwiga and her Lithuanian husband in Poland. In this final part Janko expresses implicitly the hope for a return to the better days of his youth.[120]

Janko's *Chronica* is one of the most important medieval Polish sources, and is undoubtedly the single most significant historical contribution for the fourteenth century. Its straightforward literary style is effective, but it does not compare with that of earlier works, such as Kadłubek and the *Chronica Poloniae Maioris*.[121] The work is, in addition, curiously ignorant of the major European movements which were affecting Poland in this period, despite Janko's general familiarity with the situation beyond the *regnum*. Nevertheless, despite these shortcomings, the narrative provides a fitting culmination to the historiographical tradition of this period. Its importance symbolizes the achievement in this area of learning.

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[119] The text in *M.P.H.* **2**: pp. 619–756, ed. Jan Szlachtowski. A modern critical edition of this work is badly needed. Some scholars, in particular W. Kętrzyński, "O kronice Wielkopolskiej," *Rozprawy Akademii Umiejętności, wydział historyczno-filozoficznych* **33** (1896): pp. 1–54, and Dąbrowski, *Dawne dziejopisarstwo Polskie*, pp. 154–157, have suggested that the first three sections of Janko's chronicle. which cover briefly the death of King Władysław Łokietek, the coronation of King Casimir, and the latter's rule throughout his thirty-seven year reign, do not come from Janko himself. They argue that these parts have been culled by a later editor from other Cracovian sources. The problem is complicated by the fact that the earliest manuscripts of the chronicle have no beginning and that they simply begin with the fourth section to be mentioned below. Manuscripts which do contain sections 1–3 are invariably late fourteenth or early fifteenth century in origin. The admiration for Casimir and his accomplishments which Janko shows, however, makes it unlikely that he would have completely ignored his reign in the narrative for which he was responsible. It may be, therefore, that the original beginning of the chronicle has been lost, and that later editors simply prefixed a brief, mechanical introduction. This question deserves further close textual analysis.

[120] A detailed analysis and summary of the chronicle is provided by Dąbrowski, *Dawne dziejopisarstwo Polskie*, pp. 157–160.

[121] The extremely negative judgment of Sieradzki, "Sprawa Janka z Czarnkowa i jego utwór," p. 59, is not justified.

VI. PHILOSOPHY

One final area needs to be explored briefly in this review of learning in late Piast Poland. This is the topic of philosophy. Although Poland produced no seminal thinkers or influential philosophical works in this period, manuscript marginalia suggest that native scholars were abreast of recent developments elsewhere in western Europe. Moreover, in some instances, Poles themselves wrote philosophical treatises whose intellectual characteristics foreshadow the more fully developed tendencies of fifteenth-century Polish philosophy.[122] For purposes of illustration, we shall focus upon the career and work of Jan (Johannes) of Grotków.

Jan of Grotków was born *ca.* 1300 and attended the University of Paris where he was promoted as master in arts. Upon his return from the west, he became the rector of the parish school in the Silesian city of Świdnica.[123] He lived in this area, which was ecclesiastically subject to the Archbishop of Gniezno, with his wife Anna until his death about 1352 (perhaps because of the plague in that year). Before his death he also wrote some minor philosophical treatises. The foregoing sketchy biographical details are derived from a series of notarial documents and annotations in copies of his writings, and we know virtually nothing more about him than this. They are sufficient, however, to enable us to distinguish this Jan of Grotków, educator and philosopher, from the better known Jan of Grotków, who was a physician and canon of Wrocław and Gniezno later in the century.[124] In addition we have extant the three treatises which he wrote and they provide some insight into Polish philosophy in this period.

The *Expositio in tractatum S. Thomae De ente et essentia*[125] and the *Quaestiones super De ente et essentia S. Thomae*[126] are complementary works. The first is a loosely organized, point by point discussion of several detailed sections of Aquinas's treatise. It makes no pretense to raise questions or to deal with issues implicit in the work. It is completely a work of explanation and elaboration. In discussing the relation of and distinction between the elements of a *res* in its logical, formal sense and its elements in a more existential sense, Jan Grotków draws upon authorities—both Arab and Christian—to illustrate the views of Thomas. The nature of his examples suggests, however, that he was familiar with these sources only indirectly.

The *Quaestiones* is altogether a different kind of work. Here the author has chosen several different themes that arise from Thomas's treatise. In a series of eighteen questions, he explores the conclusions offered earlier on these issues and at the same time gently intrudes subtle personal variations. At some points (for example, "Quaestio undecima: . . . utrum materia sit una et qua unitate sit una, et quod non una sit in numero"), it almost appears that Thomas's text merely serves him as a pretext for presenting his own views. To the extent that he departs from established Thomistic positions, he shows most intellectual kinship with John Duns Scotus. There is no explicit reference to the Englishman, however, in these works. From this short treatise, it is possible to see fourteenth-century Polish philosophy groping tentatively for a new, post-Thomistic approach to certain problems.[127]

This conclusion is reinforced by analysis of Jan of Grotków's third work, *De clavibus inten-*

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[122] For an introduction to this topic, see Jan Legowicz, "Z prac wstępnych nad historią miśli filozoficznej w polskim średniowieczu," *Materiały i Studia Zakładu Historii filozofii starożytnej i średniowiecznej, Series A* [hereafter cited as *Materiały i Studia*] 1 (1961): pp. 3–8; and the cooperative work by Ryszard Palacz, ed., *Filozofia Polska XV wieku* (Warsaw, 1972).

[123] The close ties between the Silesian Duchies of Świdnica and Jawór and the Kingdom of Poland during this period are sketched by Knoll, *Rise of the Polish Monarchy*, pp. 183, 207, 234; and in more detail in the older study by Erich Gospos, *Die Politik Bolkos II von Schweidnitz—Jauer 1326–1368* (Halle, 1910).

[124] See two studies by Władysław Seńko in *P.S.B.* **10**: pp. 452–453; and "Jan z Grotkowa, lekarz i Jan z Grotkowa filozof śląski z XIV w.," *Materiały i Studia* **1** (1961): pp. 60–84.

[125] This as yet unedited work is found in Cracow, Biblioteka Jagiellońska [hereafter cited as B.J.] MS 2176, ff. 37ra–57va.

[126] Contained in Cracow, B.J. MS 2176, ff. 57vb–63rb. The *Quaestiones* has received a preliminary edition by Seńko, as part of a larger article, "Charakterystyka problematyki istoty i istnienia na podstawie wyboru tekstów występujących w polskich rękopisach średniowiecznych," *Materiały i Studia* **4** (1965): pp. 9–39.

[127] See the comments of Seńko, "Polska filozofia średniowieczna—charakter, tendencje i główne kierunki," in Branisław Baczko, ed., *Filozofia Polska* (Warsaw, 1967), pp. 9 ff.

tionum.[128] This short introduction to logic is of a type common elsewhere in Europe at this time. It stands in the tradition of those authors, such as Porphirius, who sought to interpret the Categories of Aristotle. In his first paragraph, Jan makes clear his intention to concentrate chiefly upon intentions (concepts) and upon universals. This he does by defining four questions, then proceeding to an analysis of each: the relationship between primary and secondary concepts, the number of these concepts, the nature of universals, and the number of universals.[129]

Throughout, the author represents a position of moderate realism, in which universals do not exist "a parte rei," but instead are derived from the existence of individual things, although they do subsist in the intellect as general concepts. Thus, when one wishes to distinguish between concepts of the first and of the second degree, and to define how universals are generated, Jan writes:

> that a secondary concept in the concrete is the same as the material of the universal; but the secondary concept in the abstract has the same form as the universal, because the secondary concept in the concrete has the same quiddity of the thing in its intellective appearance and this is the material of the universal; a secondary concept in the abstract is the very same concept of the quiddity of the thing in relation to many substitutes and this is the form of the universal. They are different therefore and they are united.[130]

This modest and limited work apparently had some circulation. One of its copies was probably made outside of Poland,[131] while another was once in the possession of Paul of Warsaw, a bachelor at the University of Cracow in 1476.[132] This latter fact suggests that the treatise may have been used in some way in instruction in Cracow. It is also entirely probable that Jan used this work in his teaching at Świdnica. This is all the more likely since even at the lesser parish schools in this time some elementary instruction in logic and the chief problems of philosophy would have been expected.[133]

Beyond the figure of Jan of Grotków, there are no individuals in late Piast Poland who may be identified as having produced philosophical works. The few other minor treatises that are available from this time[134] are all anonymous. Not for another two generations would Poles be active participants in the scholastic tradition of the west.

VII. CONCLUSION

In all areas of learning, Poland in the last decades of the rule of the native Piast dynasty was a part of the European tradition. If Poles produced less *belles lettres* and formal philosophy than their contemporaries in the west, they were more nearly abreast in the area of law and historiography. If their academic traditions were younger and their libraries smaller than those elsewhere, they were nevertheless vital and closely tied to the needs of the kingdom and the age. It is not sheer coincidence that at a time when the *regnum* was recovering from the devastations and divisions of the thirteenth century, the greatest accomplishments in learning should come in precisely those areas where the royal initiative of King Casimir was most directly observable: in the regularization and ordering of governance and in the celebration of the accomplishments of the time. But even in those other areas of learning that were not so closely tied to the pragmatic needs of the state, it is possible to see accomplishment, which if neither so broad nor distinguished as that in the contemporary Bohemia of Charles IV,[135] was nevertheless indispensible to the flowering of Polish literature and philosophy in the Renaissance. The Piast period ends therefore with a cultural achievement which matches the contemporaneous rise of the Polish monarchy.

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[128] A provisional edition, based upon Cracow, B.J. MS 2176, ff. 101r–105r, of this work has been provided by Juliusz Domański, "Jana z Grotkowa 'De clavibus intentionum,'" *Materiały i Studia* 7 (1967): pp. 7–22. In addition to this manuscript. the works exists also in the following: Cracow, B.J. 1894 and 2118; Prague, Biblioteka Kapitulna M 43 and Biblioteka Universitecka 1999; Wrocław, Biblioteka Uniwersytecka Q 20 (fragment); and perhaps Amiens, Bibliothèque de la Ville 404 (fragment). The title also appears variously in these as *De clave intentionum* and *Liber intentionum*. All of the complete manuscripts fail to attribute the work to Jan of Grotków, and it appears as an anonymous treatise.

[129] "Sit igitur nostrae intentionis aditus, id est accessus, tali verborum serie, id est ordine, praefiguratus, ita, quod quattuor sunt disserenda: primo de intentione prima et secunda, secundo de numero earundum intentionum, tertio de universali, quarto de universalium numero" (*De clavibus intentionum,* ed. Domański, p. 7).

[130] "Quod intentio secunda in concreto idem est quod materiale universalis; sed secunda intentio in abstracto idem est quod formale universalis, quia intentio secunda in concreto est ipsa quidditas rei sub aliquo apparenti intellecta et hoc est materiale in universali; intentio secunda in abstracto est ipsemet conceptus quidditatis rei in relatione ad plura supposita et hoc est formale in universali. Differunt ergo ista et conveniunt" (*De clavibus intentionum*, ed. Domański, p. 20).

[131] Cracow B.J. MS 1894 has this notation on f. 434 v: "Finitus est iste tractatus de intentionibus anno domini 1431 . . . per me Nicolaum Polonum illo tempore nimis in penitentiis conturbatum." The copiest's designation of himself as "from Poland" and his comments about his status suggest the conclusions in the text.

[132] See Seńko, "Jan z Grotkowa," p. 76.

[133] The documents relating to Jan of Grotków's position as rector of the parish school in Świdnica are all printed in their entirety by Alfons Burda, *Untersuchungen zur mittelalterliche Schulgeschichte im Bistum Breslau* (Wrocław, 1916), pp. 348, 349, 352. He also provides a characterization of education in the city at that time.

[134] See the comments of Zofia Siemiątkowska, "Piotr Polak, filozof dominikański z XIV wieku," *Materiały i Studia* 3 (1964): p. 165; and Seńko, "La philosophie médiévale en Pologne: caractère, tendences et courants principaux," *Mediaevalia Philosophica Polonorum* 14 (1970): pp. 7–9.

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[135] See S. Harrison Thomson, "Learning at the Court of Charles IV," *Speculum* **25** (1950): pp. 1–20, for the Bohemian accomplishment.

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